SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER, 1930.

GENERAL PHYSICS.

3608. Wind Vane with Electrical Registration. R. Masek. *Zeits. f. Instrumentenk.* 50. *pp.* 384–386, *June*, 1930.

Describes an instrument with a simplified method of electrical registration of the vane position. The special feature of the instrument is its simplicity and the ease with which it can be taken down and reassembled.

J. W. T. W.

3609. Portable Instrument for Rapid Measurement of Gravity. F. Holweck and P. Lejay. *Comptes Rendus*, 190. *pp.* 1387–1388, *June* 16, 1930.

The apparatus consists of an upright pendulum formed of a rod of quartz, 10 × 0·5 cm. and covered with a thin film of platinum, fixed rigidly at its lower end into a thin sheet of elinvar, which forms one continuous piece of metal with its base. The relative sizes of the quartz rod and sheet of elinvar are such that the weight of the rod is near to that which would prevent the combination from vibrating, thus giving great sensitiveness to variations of g—up to twenty times that of an ordinary pendulum being readily obtainable. A filament at the top of the quartz rod is arranged to intercept the light from an electric lamp and so enable the vibrations to be recorded automatically by a photoelectric device. The instrument is enclosed in an evacuated glass tube. With necessary batteries, etc., the whole equipment weighs about 40 kg. and can be erected in a few minutes. A determination of g, correct to a few units in the sixth decimal place, can be obtained in ten minutes.

G. A. S.

3610. New (Micro) Method of Measuring Angle of Contact. D. Talmud and N. M. Lubman. *Zeits. f. phys. Chem.* 148. *Abt. A.* 3. *pp.* 227–232, *June*, 1930.

The method consists essentially of examining a suitably illuminated drop of the liquid in two microscopes. One of these instruments (with its axis vertical) is used to determine the diameter of the drop, and the other (with its axis horizontal) serves to measure the height. From formulæ given in the paper the angle of contact can be determined from these quantities.

G. E. B.

3611. Machine for Calculating with an Integrating Planimeter the Product of Two Functions. A. Nessi and L. Nisolle. *Comptes Rendus*, 190. *pp.* 1479–1481, *June* 23, 1930.

The numerical solution of certain integral equations of Volterra and the calculation of the coefficients from the development in a series of fundamental functions leads to the evaluation of an expression of the form

$$\int_0^t f(s) \,.\, g'(t-s)ds \quad \text{or} \quad \int_0^t f(s) \,.\, g_s'(s) \,.\, ds$$

One can use for the solution that of the Cauchy problem for an ordinary linear differential equation of any constant coefficients, such as the resistance of materials, tracing the line of moments or of elasticity, calculations of moments of inertia, detection of the centre of gravity or heating with varying intensities for complex systems. Former apparatus necessitated two or three operators. The new apparatus and the theory of its action are described. It requires only one operator, and can be registered by any planimeter. R. S. R.

3612. Surface Tension. A. W. Porter. *Phil. Mag.* 9. *pp.* 1065–1073, *June*, 1930.

The author investigates the theory of the bubble-pressure method for liquids such as mercury with an angle of contact between 90° and 180°. He shows that either the internal or the external radius of the bubble-jet may decide the magnitude of the maximum pressure, according to their ratio. The maximum pressure is a function of the angle of contact when it is determined by the internal radius, but not in the other case. Tables and diagrams are given to assist in choosing the appropriate radii for use with a given liquid. [See also Abstract 438 (1930).] L. V. C.

3613. Capillarity. Migration of Salts in Gels due to Evaporation. K. Schultze. *Kolloid Zeits.* 51. *pp.* 299–308, *June*, 1930.

Further discussion and illustration of the phenomena observed when sodium silicate is treated with hydrochloric acid of various concentration and the precipitated gel is dried [see Abstract 2383 (1930)], and with other gels containing salts. The efflorescence of crystals is frequently ascribed to the pressure which the drying gel exerts on the solution within it, but the crystal formation is not due to contraction. Alkaline and acid silica gels behave differently. Efflorescence of crystals is only observed in the latter. In the alkaline gel the salt concentration is small, and the upper layer of crystals forms under a layer of gel which is already too strong to be pierced by crystals. H. B.

3614. Viscosity of Gases and Vapours. Part III. Influence of the Dipole Moment on the Size of the Sutherland Constant. H. Braune and R. Linke. *Zeits. f. phys. Chem.* 148. *Abt. A.* 3. *pp.* 195–216, June, 1930.

In deriving his well-known formula Sutherland assumed rigid molecules of definite cross-section. The molecules exert attractive forces on each other, and the consequent shortening of the mean free path is allowed for by an increase in the effective cross-section. But at low temperatures it is necessary to introduce a factor $1/(1 + C/T)$, where C is proportional to the potential energy of the molecule at contact. The Sutherland equation can be written in the form $\eta = K \,.\, T^{\frac{3}{2}} \,.\, /(T + C)$, where η is the internal friction, which the authors have experimentally determined over a wide range of temperature for NH_3, H_2O, HCN, Cl_2, I_2, etc., and have incidentally found that the cubes of the diameter of the methane molecule plot as a straight line against the number of chlorine atoms introduced into it. Tables of η are given with values of C and K. A formula for the determination of C given by Falkenhagen is discussed, and it is found that only for large values of the dipole moment does reasonable agreement exist between the observed and calculated values of C. A practically straight line is obtained by plotting the logarithms of the ratio between the values of C against $(v/a) \cdot 10^4$, where $v = \pi N\sigma^3/6$; a = the van der Waals constant; N = the Loschmidt number; σ = the diameter of the molecules. T. B.

3615. Variation of Viscosity of Cellulose Solutions with Temperature. E. Berl and H. Umstätter. *Zeits. f. phys. Chem.* 148. *Abt. A*. 6. *pp*. 471–474, *June*, 1930.

The viscosimeter used consists of a glass capillary 0·03 cm. diameter, 25 cm. long, fused at both ends to wider tubes (0·2 cm.) 20 cm. long. The whole is inserted in a glass cylinder filled with dilute caustic soda, which is heated by direct currents. When the fluidity $1/\eta$ is plotted against the square of the temperature, all the curves obtained in the temperature range 20° to 48·5° C. are practically straight lines. The solutions consist of cellulose acetate (2, 3 or 4 %) in acetone and cellulose nitrate (2 or 4 %). Since symmetric molecules are more affected by temperature in their viscosity than asymmetric molecules, the experiments point to an analogy of the cellulose to symmetric molecules. H. B.

3616. Hydromechanics of Bilateral and Arched Plates. U. Cisotti. *Accad. Lincei, Atti*, 11. *pp* 122–128, *Jan*. 19, 1930.

Gives two examples of rigid plates which undergo a dynamical action from a fluid circulating within them [see Abstract 1280 (1930)]. One is a bilateral angular plate and the other a plate with a cross-section in the form of a circular arc. Finds the value of the resultant force, which is directed towards the convexity. [See also following Abstract.]

E. E. F. d'A.

3617. Hydrodynamics. U. Cisotti. *Accad. Lincei, Atti*, 11. *pp*. 335–343, *Feb*. 16, 1930.

Following previous work [see preceding Abstract], investigates the preceding resultant of translatory-local-circulatory streams on a profile bent into an arc. [See also following Abstract.] A. D.

3618. Hydrodynamics. B. Finzi. *Accad. Lincei, Atti*, 11. *pp*. 395–399, *Feb*. 16, 1930.

Studies the amount of power necessary to keep up the flow in Cisotti's case [see preceding Abstract]. A. D.

3619. Hydrodynamic Stability. Part I. Uniform Shearing Motion in a Viscous Fluid. R. V. Southwell and L. Chitty. *Roy. Soc., Phil. Trans.* 229. *pp*. 205–253, *May* 31, 1930.

The stability of laminar flow of a fluid between two plane and parallel boundaries, which have a uniform velocity relative to one another in a direction parallel to their planes, is investigated mathematically, so that the critical velocity of steady flow may be estimated approximately in cases where exact solutions are not obtainable. The paper includes a critical review of previous work, indicating why the question still awaits a really satisfactory answer, and certain preliminary results having an interest of their own. In Section I, work of Kelvin, Rayleigh, Orr, Oseen and Reynolds is discussed. Section II examines the possibility of inferring stability from an integral equation differing in form from that used in

Reynolds' method. It is shown that the problem cannot be simplified by partial neglect of viscosity, as in Rayleigh's earlier work. Section III describes the "method of normal coordinates" entailing a study of disturbances varying according to a simple exponential factor of the time. This method affords a complete solution for infinitesimal disturbances when the plane boundaries are at rest. The so-called "conjugate relations" ordinarily possessed by "normal" solutions are not satisfied. A more exact discussion of "normal" disturbances is undertaken in Section IV. J. S. G. T.

3620. Motion of Vortices in an Ideal Fluid Affected by Plane Boundaries. W. Müller. *Zeits. f. angew. Math. u. Mechanik*, 10. *pp.* 227–243, *May–June*, 1930.

The motions of one or two vortices in an ideal fluid confined either within a rectangular boundary or in a canal are deduced mathematically. [See Abstract 627 (1923).] J. S. G. T.

3621. Vortex Orbits about Infinitely Thin Walls and Laminæ. W. Barth. *Zeits. f. angew. Math. u. Mechanik*, 10. *pp.* 247–251, *May–June*, 1930.

Vortex motion about a finite plane is discussed mathematically.

J. S. G. T.

3622. Hot-Wire Amplifier Method for Measuring the Distribution of Vortices behind Obstacles. E. Tyler. *Phil. Mag.* 9. *pp.* 1113–1130, *June*, 1930.

A differential hot-wire method, employing a five-valve amplifier, is used for the measurement of the longitudinal and lateral spacings of vortices behind cylinders, and for estimating the frequency formation of vortices behind cylinders, inclined plates and aerofoils. Empirical formulæ embodying the results obtained show good agreement with theory. [See Abstract 453 (1930).] J. S. G. T.

3623. Spread of Vorticity in the Wake Behind a Cylinder. L. Rosenhead. *Roy. Soc., Proc.* 127. *pp.* 590–612, *June* 2, 1930.

In a two-dimensional disturbance the Bénard-Kármán street is stable for the stability ratio 0·281 for all values of the thickness of the vortices. In a three-dimensional disturbance, if the wave-length of the disturbance along the axis of the street is large, the system is found to be stable for all values of the thickness of the vortices. In a general disturbance where components have small wave-lengths, these give instability and tend to break up the configuration, the vortices becoming increasingly distorted, while the distance between the rows decreases or increases. In the first case the system always will be unstable, and the double row will disappear. In the second case a position of transitional stability will be reached, and finally the distance between the rows will no longer increase, and the vortices become not more distorted. The increase in thickness of the vortices now becomes the dominant factor, and with the spread of vorticity the system, though always stable, will tend to close its ranks and disappear. Thus, in a trail behind a cylinder the first few vortices are given by a stability ratio of about 0·281, while those farther away become increasingly distorted, and either come together and lose their identity or at first tend to increase the distance between the rows, and finally come together as the vorticity diffuses. [See also Abstracts 380 and 672 (1929).] R. S. R.

3624. Simple Capillary and Gravitational Waves in Flowing Media. Part II. K. Uller. *Zeits. f. angew. Math. u. Mechanik,* 10. *pp.* 284–299, *May–June,* 1930.

Part I [see Abstract 446 (1930)] dealt with waves which were possible at the boundary of two flowing media for the case of no external forces, and where only boundary surface forces exist. The present entirely mathematical paper considers purely gravitational waves, and includes the treatment of the resonance capability of liquid and gaseous bodies in the gravitational field. H. H. Ho.

3625. Conception and Measurement of Plasticity. The C.G.S. Unit and a New Plastometer. E. Karrer. *Zeits. f. techn. Physik,* 11. 8. *pp.* 326–337, 1930.

The paper commences with a general and historical introduction, and discusses the lack of uniform usage of the term plasticity in science and technology. Following this comes a discussion of the properties denoted by the term (elastic yield and permanent set) in conjunction with other properties, rubber wares being cited as examples. Attempts to ascertain the degree of plasticity by means of a proposed plastometer are described, and the ideal data for an exact formulation are considered. Details of construction of a new plastometer are given, and the significance of plasticity measurements indicated. A table showing the relative plasticities of a number of common materials is included, together with a short bibliography of the subject. H. H. Ho.

3626. Compressibility of Rubber. L. H. Adams and R. E. Gibson. *Washington Acad. Sci., J.* 20. *pp.* 213–223, *June* 19, 1930.

Observations are made at 25° C. and over a range of pressure up to 12,000 bars (1 bar $= 10^6$ dynes/cm.^{2}) on three samples of rubber. The compressibility of sample 1, a hard rubber containing only 0·21 % of free sulphur, is accurately represented by a cubic function of the pressure over the range studied; that of samples 2 and 3, soft vulcanised rubbers containing respectively 10 % and 4 % of free sulphur, is best represented by an exponential function of the form: $-\Delta V/V_0 = A + B_p + C(1 - e^{-Dp})$, though the agreement is not so good as in sample 1. The experimental curves are shown to resemble (*a*) those for a compressible solid (*e.g.*, potassium in the case of sample 1, and (*b*) those for a liquid (*e.g.*, amyl alcohol) in samples 2 and 3. L. V. C.

3627. Dynamics of Cords and Ropes. Part IV. H. Schmidt. *Zeits. f. Physik,* 62. 9–10. *pp.* 696–711, 1930.

Gives the general theory of forced vibrations, taking movable loads specially into account. The formula derived is specialised to cover the case of single loads, variable with the time, and explained with reference to a known example from the Helmholtz theory of the action of piano hammers. Finally, it is made use of to determine the action of loads with uniform and with accelerated velocity. [See also Abstract 2395 (1930).] H. N. A.

3628. Motion of Spherical Pendulum. A. O. Rein. *Tohoku Math. J.* 32. 3–4. *pp.* 348–351, *June,* 1930. *In German.*

Integration of the equations of motion of the spherical pendulum for particular cases in which the solutions can be expressed without the use of elliptic functions. G. C. McV.

3629. Theory of the Spiral. J. Haag. *Comptes Rendus,* 190. *pp.* 1271–1273, *June* 2, 1930.

The theory of pendular spiral motion contained in a previous paper [see Abstract 18 (1930)] is amplified. J. S. G. T.

3630. Propagation of Waves upon Elastic Surfaces of Three Parameters. L. Roy. *Comptes Rendus,* 190. *pp.* 1332–1334, *June* 11, *and pp.* 1475–1477, *June* 23, 1930.

The first paper gives an application of general formulæ recently derived [see Abstract 2394 (1930)] to surfaces of three parameters, when it is established that a wave cannot be propagated upon an elastic surface affected by viscosity, and that the laws of propagation established for impact waves remain valid for waves of acceleration and for waves of higher order. The second paper shows that the equations of the general case reduce to simple forms when the elastic surface considered is isotropic, the cases of bad and good conduction of heat being also discussed. H. H. Ho.

3631. Funicular Surfaces. L. Lecornu. *Comptes Rendus,* 190. *pp.* 1345–1349, *June* 16, 1930.

Considering the case of a plain network consisting of flexible non-extensive filaments with rectangular corners and fastened at the joints, if external forces are applied the calculations necessary to determine the final state of equilibrium are very complicated. The author considers the case of infinitely small sections in which in the limit a funicular surface is obtained. Equations are established and can be applied to the problem of a heavy funicular surface of hammock shape, and the arbitrary functions only are then required for integration to obtain the conditions imposed by the method of suspension. R. S. R.

3632. Crystal Structure of Rubidium Azide. L. Pauling. *Zeits. f. phys. Chem.* 8. *Abt. B.* 4. *pp.* 326–328, *June,* 1930.

Exception is taken to the structure proposed by Günther, Porger and Rosbaud [see Abstract 2404 (1930)], because it leads to a value of 1·45 Å. for the distance between nitrogen atoms belonging to two neighbouring azide ions, instead of about 3·5 Å. as would be expected theoretically. Earlier work [see Abstract 1987 (1927)] suggested isomorphism of RbN_3 (and TlN_3) with KN_4, which should give the parameter u for $RbN_3 = 0 \cdot 129$ approximately. Weak layer lines between those observed by Günther, Porger and Rosbaud should occur. In the *Reply* by **Günther** and **Rosbaud** (*ibid.*, p. 329), such intermediate layer lines are reported for a rotation photograph of RbN_3 about the a axis on very long exposure. Further information is promised. F. I. G. R.

3633. Crystal Structure of Pentaerythritol Tetraformate. M. A. Bredig. *Zeits. f. Krist,* 74. *pp.* 49–55, *June,* 1930.

A rhombic elementary cell is obtained with $a = 19 \cdot 80$ Å., $b = 9 \cdot 90$ Å., $c = 11 \cdot 70$ Å. Length of unit cell = 19·80 Å. Eight molecules in the unit cell. Space group V_h^{15}. The chemical evidence is in favour of a molecular lattice. The paper concludes with a discussion of Weissenberg's hypothesis as far as it is applicable. F. I. G. R.

3634. Space-Group of 2, 4, 6-Tribromobenzonitrile. M. A. Bredig. *Zeits. f. Krist.* 74. *pp.* 56–61, *June,* 1930.

The elementary parallelepiped has $a' = 12 \cdot 50$ Å., $b' = 10 \cdot 30$ Å., $c' = 4 \cdot 87$ Å., and contains two molecules $C_6H_2Br_3CN$. The space-group is C_{2h}^2, in accordance with Weissenberg's theory. Etch figures on the faces *a* (100) and *a′* (100) indicate the presence of a diad axis perpendicular to the plane of symmetry. Piezoelectricity is not found; the substance may be an unfavourable case, but the absence of the effect is not in contradiction with the class C_{2h}. F. I. G. R.

3635. Crystal Structure of the Triodides of Arsenic, Antimony and Bismuth. H. Braekken. *Zeits. f. Krist.* 74. *pp.* 67–72, *June,* 1930.

The three iodides are shown to be isomorphous. BiI_3 apparently shows ditrigonal symmetry, the others only trigonal. The axial-ratios ($a:c$) are: AsI_3, 1:2·977; SbI_3, 1:2·798; BiI_3, 1:2·758. The basis cell contains six molecules MI_3. Results lead to a radius 2·17 Å. for I^- in BiI_3, in good agreement with Goldschmidt's tabulated value of 2·20 Å. Bi^{3+} has a radius of approximately 1 Å., but may be greater; an accurate figure is impossible on account of polarisation. The other two salts are essentially similar, but with somewhat deviating parameters not yet definitely established. The family BiI_3, SbI_3, AsI_3, (PI_3) forms a group in which the first is a pure layer lattice: the others tend in the above order towards molecular lattices. This transition agrees with the chemical properties. F. I. G. R.

3636. Crystal Structure of Magnesium Nitride Mg_3N_2. G. Hägg. *Zeits. f. Krist.* 74. *pp.* 95–99, *June,* 1930.

The work of Ott [see Abstract 1393 (1924)] makes it of interest to investigate nitrides in order to compare in them the ionic radius of nitrogen. Mg_3N_2 has a body-centred cubic lattice of edge = 9·93 Å., and contains twelve molecules. This should yield a density of 2·043, whereas 2·06 is found. The orange-coloured modification which is observed at high temperatures is not attributed to change of structure, but to alteration of grain size. F. I. G. R.

3637. Crystal Structure of Thallium. S. Sekito. *Zeits. f. Krist.* 74. *pp.* 189–201, *June,* 1930.

α-Thallium, stable below 230° C. [see Abstract 941 (1920)], has a hexagonal close-packed structure, with $a = 3{\cdot}450$ Å., $c/a = 1{\cdot}600$, and not, as has been suggested, a face-centred tetragonal structure. The crystal structure of β-thallium, stable above 230° C., is determined from specimens made by quenching the molten metal in ice-water, and is found to be face-centred cubic, with lattice constant $a = 4{\cdot}841$ Å. A. J. M.

3638. Energy of Crystal Lattices. H. Jones. *Roy. Soc., Proc.* 127. *pp.* 689–703, *June* 2, 1930.

Using the quantum mechanical perturbation theory to calculate the potential energy of a lattice of atoms the lattice constant of which is reduced adiabatically from a very large value, a crude approximation is obtained by assuming the initial wave functions (products of the wave functions of the individual atoms) orthogonal. But this method gives little indication of the true result. It leads, for example, to the conclusion that a cubic lattice of hydrogen atoms with no resultant spin would always have much lower energy than the same number of atoms in pairs, the distance between the atoms of a pair equalling that between nearest neighbours in the lattice. Actually hydrogen is a diatomic gas which preserves its molecular character even when liquefied or solidified. The present calculations do not assume the initial wave functions to be orthogonal for nearest neighbours in the lattice. One result obtained is that the coefficient of the interchange term in the expression for the mean energy decreases as the lattice is closed in, and the potential energy of the crystal depends more on the ordinary electrostatic potential energy of the Schrödinger space charge and less on the interchange energy than in the case of a diatomic molecule. Applied to the case of hydrogen atoms in a simple cubic lattice, the method gives a mean energy of the same order of magnitude as for the same number of atoms forming a diatomic gas. The case of atoms possessing a closed shell lying behind the single valency electron is also discussed. W. S. S.

3639. Motion on a Lattice. C. H. Dix. *Nat. Acad. Sci., Proc.* 16. *pp.* 426–430, *June*, 1930.

A mathematical discussion of a lattice theory according to the method of Courant, Friedricks and Lewy, without considering any process in which the mesh width continually approaches zero. J. J. S.

3640. Quantum Mechanics of Electrons in Crystals. P. M. Morse. *Phys. Rev.* 35. *pp.* 1310–1324, *June* 1, 1930.

A general solution is developed for the motion of electrons in the potential field of the nuclei in a crystal lattice. It is shown that for low energies the wave function becomes the linear combination of the atomic wave functions, the allowed energies approximating to the discrete atomic levels, and for high energies the wave function approaches that of the free electron, with the allowed energies a nearly continuous range. But for electrons coming into the crystal from outside, the crystal becomes impenetrable for those electronic wave-lengths and directions analogous to the beams producing Bragg and Laue beams in X-rays. A solution is computed for a simple form of space lattice, and the results are shown to be in quantitative agreement with the results of Davisson and Germer.

E. E. F. d'A.

3641. Electrostatics of the Space-Lattice. M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 2. *pp.* 26–41, 1930.

Experiments on the diffraction of electronic rays have directed attention not only to the periodic potential fluctuations which are immediately connected with the periodicity of the space-lattice, but also to the spatial mean value of the electrostatic potential, which is of special importance for the calculation of the refractive index of a crystal with respect to electronic rays. This entirely mathematical paper investigates the spatial mean value under the following sections: geometry of the boundary layers [see Abstract 327 (1919)]; potential of the single layer and of the semi-space lattice; average potential in a universally limited space-lattice; transition to the continuum theory; applications. [See also Abstract 194 (1920).] H. H. Ho.

3642. Scattering Powers of Atoms in Magnesium Oxide for X-Rays and Some Related Properties. G. W. Brindley. *Phil. Mag.* 9. *pp.* 1081–1094, *June*, 1930.

In view of the uncertainty of the method of Fourier analysis for determining the relation between the scattering power of an atom and the number and distribution of its electrons an alternative method has been devised based on the radial distribution of charges in the atom and a temperature factor to correct for thermal vibration [see Abstract 844 (1929)]. Scattering, *i.e.*, $F/(\sin\theta/l)$ curves, have in this way been calculated for O, O^{-2}, Mg and Mg^{2+} from the experimental data of Wyckoff and

(Miss) Armstrong [see Abstract 2085 (1930)]. The curves for O and O^{-2} are very similar, but agreement is slightly better for the unionised atom. A marked falling off of F for large values of sin θ/λ seems connected with the use of powdered crystals, nothing of the sort occurring in the case of a single aluminium crystal [see Abstract 1076 (1930)]. The curves for Mg and Mg^{+2} are so identical that no deduction is possible. The amplitude of vibration of the atom in the lattice is estimated as 0·09 Å. for oxygen, and 0·11 Å. for magnesium. C. A. S.

3643. Nuclear Classification of Atoms in Relation to Their Possible Genesis and Radioactive Disintegration. G. Fournier.

J. de Physique et le Radium, 1. *pp.* 194–205, *June*, 1930.

Neither the atomic number N nor the atomic weight A is capable of distinguishing unambiguously an atom or an isotope, and the magnitude U is chosen for this puprose, where U is $(3A/4) - N$, U being such that it decreases by unity for any passage from a radioactive atom to its direct descendant by an α or β emission. The quantity U assumes a wider meaning if the process of disintegration is supposed possible from lead to the lightest elements, its integral part being equal to the number of α or β changes of which the atom is capable. Taking A as a multiple of $4 + \pi$, the atoms are arranged in four families, for which π is respectively 0, 1, 2 and 3. Of these the first three include the radioactive families of thorium, actinium and uranium; the fourth has no radioactive representative. The table exhibits the nuclear significance of the relation between A and N; equilibrium tends to be conserved between the number of helions (helium nuclei) in the nucleus and the number of free nuclear electrons, so that if the former varies as the series of prime numbers, its excess over the latter varies as the series of odd numbers. [See also Abstracts 55 and 2096 (1930).] G. E. A.

3644. Undulatory Theory of Quantic Phenomena. L. Décombe.

Comptes Rendus, 190. *pp.* 1385–1387, *June* 16, 1930.

The theory [see Abstracts 919 and 1755 (1930)] is now applied to band spectra, which are explained by attributing to the tubes of force uniting the two ions two superposed vibrations, the one radial, the other azimuthal, on which depend respectively the vibrational and rotational spectra. Under certain circumstances the one vibration can affect the other. Deslandres' term is attributed to oscillations of the ions with respect to the paths which the rotation of the whole molecule around its centre of gravity causes it to describe. By extending the idea of the spinning electron to the proton it is shown that there must be resonance between the rotation frequencies of electron and proton. The author claims priority in respect to his theory [see Abstracts 787 (1925), etc.] over Sevin [see Abstract 2505 (1929)] and de Donder [see Abstract 3049 (1930)]. C. A. S.

3645. Interaction of Free Electrons with Radiation According to Dirac's Theory of the Electron and Quantum Electrodynamics. I. Tamm.

Zeits. f. Physik, 62. 7–8. *pp.* 545–568, 1930.

Dirac's wave equations are used to determine the wave functions of the free electron (a simple method for manipulating these wave functions is introduced) and the radiation field is also quantised. In this way a formula is derived for the scattered radiation from free electrons which is identical with the Klein-Nishina result, but which does not rest on an appeal to the correspondence principle to evaluate the radiated intensity from the distribution of the electron current. It appears that quantum jumps to intermediate states of negative energy play a determining part in the scattering process. In addition, the probability of a spontaneous transition of an electron from a positive to a negative energy level is evaluated and shown to equal to the classically estimated probability of collision between two electrons of relative velocity c. Such a transition would correspond in Dirac's recent theory of the proton to the transformation of the matter of the electron and proton into radiation. Applying the result obtained to an atom, an impossibly short life period for the atom is obtained (of the order 10^{-3} sec.), and this appears to be a fundamental difficulty for the new Dirac theory of the proton if the assumptions of the present analysis are justified. W. S. S.

3646. Rôle of the Eigenenergy of the Electron in the Quantum Theory of Radiation. I. Waller. *Zeits. f. Physik,* 62. 9–10. *pp.* 673–676, 1930.

The question of the reaction of the field of a free electron on the electron itself is discussed in terms of the Dirac radiation theory. Both in the relativistic and the non-relativistic theories there appear to be fundamental difficulties in connection with this point. W. S. S.

3647. Dirac's Equation. A. Proca. *Comptes Rendus,* 190. *pp.* 1377–1379, *June* 16, 1930.

Calls attention to certain faults in Dirac's equation, an absence of symmetry, a non-tensorial form, the demivector character of ψ, and the absence of an immediate physical interpretation. Shows that as usually treated ψ is regarded as having four components, ψ_1, ψ_2, ψ_3, ψ_4, and as a matrix with four lines and a single column; but that the most general solution of ψ is a matrix of four lines and four columns, depending on sixteen components ψ_k, and not on four. Quite apart from the quantum theory, sixteen physical magnitudes are necessary to determine an electron, four coordinates, four moments, three components of the magnetic moment, three others for the electric moment (Frenkel), the mass and the de Broglie wave-length, or better the mass and its conjugated coordinate. Using Eddington's language, it may be said that, effectively, the electron has sixteen degrees of freedom, and that the sixteen components ψ_k are related to these degrees of freedom. H. N. A.

3648. Oscillator Problem in Dirac's Theory. K. Nikolsky. *Zeits. f. Physik,* 62. 9–10. *pp.* 677–681, 1930.

Dirac's wave equations for the electron are considered for the case of a particle attracted to the origin by a force proportional to the x-component of its distance from the origin. The energy operator is found not to have a discrete, but instead a continuous spectrum. The wave functions remain finite at infinity, but certain values of the energy can be selected for which the amplitude at infinity is specially small and these values can in a certain sense be regarded as eigenvalues. The oscillator problem presents the same kind of difficulty when treated by the Klein-Fock relativistic wave equation of the second order. The difficulty appears to be of relativistic origin. W. S. S.

3649. Events and Observations in Wave Mechanics. E. Madelung. *Zeits. f. Physik,* 62. 11–12. *pp.* 721–725, 1930.

Discusses the meaning of the words "event," "state" and "observation" in wave mechanics. An event cannot be observed in a free selfcontained system without interference. The author points out that it is necessary to know the quantum state of the system, and this is generally possible. He applies his reasoning to the problem of the resonance pendulum. E. E. F. d'A.

3650. Distribution of Potential and Charge in a Diatomic Molecule. L. Goldstein. *Comptes Rendus*, 190. *pp.* 1502–1504, *June* 23. 1930.

The author extends the Fermi-Thomas method of determining the distribution of potential and charge round a nucleus by treating the electrons as forming a spherical gas cloud obeying the Fermi statistics, to the case of a diatomic molecule. As an approximation it is assumed that one can superpose linearly the potential and charge distributions of the component atoms. This procedure neglects the effect of Pauli's principle applied to the complete electron cloud. As it is only the outermost electrons which are concerned in molecule formation, it is deduced that the distribution derived in this way will more nearly approach the actual distribution for heavier molecules. W. S. S.

3651. Problem of Three Bodies. W. Kusnetzoff. *Accad. Lincei, Atti*, 11. *pp.* 568–574, *March* 16, 1930.

Shows how with a single canonical transformation coordinates and moments may be introduced which all remain as regular functions of an auxiliary parameter from time minus infinity to time plus infinity, even through instants at which binary collisions occur. A. D.

3652. Two-Body Problem from the Point of View of the Special Relativity Theory. J. Zahradníček. *Zeits. f. Physik*, 62. 9–10. *pp.* 687–693, 1930.

Taking into account the result of special relativity, that the mass of a body in motion is a function of its velocity, $m = m_0\sqrt{1 - \beta^2}$, the equations of the Kepler problem are derived for the special cases where m_2 is *much* greater than m_1, $m_2 > m_1$, $m_2 = m_1$, $m_2\beta_2 = - m_1\beta_1$. Elliptical orbits with precessing perihelion are found in the first three cases, the fourth gives the ordinary Kepler laws. H. N. A.

3653. Compatibility of the Field-Equations in the Unitary Field-Theory. A. Einstein. *Preuss. Akad. Wiss. Berlin, Ber.* 1. *pp.* 18–23, 1930.

A discussion of a new set of field-equations arising from the unified theory of electricity and gravitation lately proposed by the author. The field variables are sixteen in number, and since the field equations must leave four of these arbitrary, the number of field equations must be twelve. Twelve covariant equations cannot be found, hence the author proposes a set of twenty-two, between which ten identical relations exist. These identities are worked out. A solution to the first approximation, *i.e.*, when the field considered departs only slightly from a Euclidean one, is worked out and the usual equation for the gravitational potential as well as Maxwell's electromagnetic equations are obtained. It is concluded that for a more accurate solution it would be impossible to separate the electromagnetic from the gravitational equations in this way. [See also following Abstract.] G. C. McV.

3654. Statical Solutions of Equations of Unitary Field-Theory. A. Einstein and W. Mayer. *Preuss. Akad. Wiss. Berlin, Ber.* 6. *pp.* 110–120, 1930.

Two solutions for spherical symmetry of the field-equations of the unitary theory of electricity and gravitation [see preceding Abstract]. One solution corresponds to a charged mass. Two constants of integration occur, one of which is taken to be the mass, the other the electric charge of the particle. If the charge is not zero, the Riemannian metric of the space surrounding the particle is such that the cross terms in $dx^a dt (a=1, 2, 3)$, where the x^a represent space coordinates and t is the time, do not vanish, so that the space is not isotropic in the coordinates employed. The other solution corresponds to that of n mass-points, at rest with respect to each other, the masses being uncharged. The solutions are not the same as those obtained on the general relativity theory for the corresponding problems. G. C. McV.

3655. Instability of the Einstein Spherical Universe. A. S. Eddington. *Roy. Astron. Soc., M.N.* 90. *pp.* 668–678, *May*, 1930.

An account of some of the more important properties of the spherical universe with expanding radius discovered in 1927 by Lemaitre. In this universe the velocity of recession of the nebulæ is interpreted as due to the rate of expansion of the radius of the universe and gives, as the present rate of this expansion, a rate of 1 % in 20 million years. Further, it can be shown, by calculating the pressure and density of matter in this universe, that the Einstein universe is an unstable one, *i.e.*, a universe which started as an Einstein universe would inevitably, the moment the slightest disturbance was set up, become an expanding (or contracting) universe of the type considered by Lemaitre. The actual universe appears to have started as an Einstein universe with radius about 12×10^8 light-years and to have expanded considerably since. The actual amount of this expansion cannot be determined, however, since it involves a knowledge of the mean density of matter in the universe, a quantity which cannot be found experimentally. Another property of an expanding universe is that although an observer at a point can see all parts of the universe, he is not visible from all parts, because the velocity of light in angle (*i.e.*, fraction of the whole circuit round spherical space) decreases as the radius of space increases. Finally, it is probable that in the actual universe the expansion has proceeded so far that the de Sitter universe is a better approximation to actual conditions than the Einstein, since the former is the limit of an expanding universe when the radius is so great that the density of matter is nearly zero. G. C. McV.

3656. A Class of Solutions of Einstein's Gravitational Equations in Continuous Matter. J. Ghosh. *Tohoku Math. J.* 32. 3–4. *pp.* 234–238, *June*, 1930. *In English.*

Types of exact solutions of Einstein's gravitational equations in the most general form, $K_{pq} - g_{pq}K/2 + \beta g_{pq} = -8\pi T_{pq}$, K_{pq} denoting the contracted Riemann-Cristoffel tensor, and T_{pq} the material energy tensor are investigated for fields occupied by matter possessing internal stresses. When the field is symmetrical about the origin the two transverse stresses are identically equal. The radial and transverse components may be given as functions of r, but, in general, a relation between them is sufficient for the determination of the field when T_4^4 is given. T_2^2 and T_1^1 are assumed to be linearly related, this relation being probably the only one which leads to exact solutions of the equations. [See also Abstract 2923 (1928).] J. S. G. T.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3657. Certain Limitations on the Possible Values of the Ratio of Heat Losses by Convection and by Evaporation at a Water Surface. N. W. Cummings. *Monthly Weather Rev.* 58. *pp.* 142–144, *and* 144–146, *April*, 1930.

A method employing determinants has been used to obtain a graph of the Bowen formula for R, the ratio of the sensible heat swept away by the wind to the latent heat, carried off by the vapour. This diagram facilitates numerical calculations of the evaporation from an open water surface, and it also sets limits on the value R can attain under certain special conditions which alone are insufficient for its exact evaluation. Curves are then constructed which connect the dry and wet bulb and water-surface temperatures with R. The values obtained from this diagram are compared with those calculated from the Clapeyron equation, the empirical equation, and by numerical differentiating. These limits which can be set on R are thought to be of great value in connection with theories of climatic change, particularly glaciation. [See Abstract 283 (1928).] R. S. R.

3658. Theory of Upper Atmospheric Ozone. S. Chapman. *Roy. Meteorolog. Soc., Mem.* 3. *pp.* 103–125, *June*, 1930.

The paper provides a quantitative theory of the equilibrium and changes of ozone and atomic oxygen in the upper atmosphere, and involves a consideration of the amount of O at the level of maximum O_3 density and the daily and annual variations of the O_3 content in the atmosphere in any latitude up to about 50°. The O_3 content is considered uniform in a layer of air 10 km. thick and having the same density as the air at the level of maximum O_3 density. It is supposed formed and decomposed in this O_3 layer, the radiation band 1300–1800 Å. forming it by dissociation of O_2, and the band 2300–2900 Å. decomposing it. The intensities of these radiations are supposed approximately those for a black body at 6000° and their photoelectric efficiencies not low. The action of corpuscular radiations is rejected. By day the dissociation ($O_3 = O + O_2$) is compensated by rapid reformation $O + O_2 = O_3$. The inconspicuous diurnal variation of O_3 gives a lower limit for this rate of recombination. In as far as dissociation and recombination balance, the amount of 0_3 is unaltered, but O_2 in dissociating gives new atoms of O and so increases the amount of O_3. This is supposed balanced by the process $2O = O_2$ and $O + O_3 = 2O_2$. These are mainly day reactions and most of the O atoms then present have been formed from O_3. Provided suitable values are taken for the cofficients of these reactions, their varying rates can explain the annual variation of O_3. It is shown that one of the most definite tests of the theory would be observations (by ultra-violet absorption in moonlight) of O_3 in the Arctic Circle during the period of continuous darkness when the amount should be constant. [See Abstract 2120 (1929).] R. S. R.

3659. Heavy Ions in the Atmosphere. Part II. H. Israel. *Gerlands Beitr. z. Geophys.* 26. 3. *pp.* 283–313, 1930.

The observations outlined in Part I [see Abstract 537 (1930)] have been extended over a period of twelve months, and in a table are given the numbers of positive and negative, small and large ions, dust nuclei, wind, temperature, relative humidity, visibility, nature of air mass and temperature difference between Frankfurt and the Taunus Observatory. The results expressed previously are largely confirmed. For different air masses polar air shows fewer large ions than tropical air, least for old polar air and low relative humidity, and most for mixed air at surfaces of discontinuity. The same relation holds for dust nuclei but a reverse relation for small ions. With increased vapour pressure there are fewer large ions and dust nuclei. The annual changes show a maximum of large ions in winter and a minimum in summer. For dust nuclei the relation is similar but much feebler, and for small ions the relation is reversed. Diurnal changes give maxima at 4 and 14 hours and minima at 8 and 19 hours. Effects of turbulence are shown in the corresponding temperature differences at Frankfurt and Taunus. R. S. R.

3660. Temperature Anomalies and the Earth's Axis. R. Spitaler. *Gerlands Beitr. z. Geophys.* 26, 3. *pp.* 351–359, 1930.

Following previous work [see Abstract 2462 (1930)] in which data are given for Vienna, the available data for the other observatories of the world have been examined in a similar manner. The results are generally confirmatory of the previous conclusions, but the available data are as yet inadequate. A. D.

3661. Continental Drift. W. Jardetzky. *Gerlands Beitr. z. Geophys.* 26. 2. *pp.* 167–181, 1930.

All planets in the gaseous or fluid state have a differential zonal rotation, which will produce various effects when the planet possesses floating Continental masses. The earth is still in the state of increasing angular velocity which varies from the poles to the Equator. The forces that appear to arise in this way are applied to a consideration of the fissuring of the earth's crust and to the drift of continents. W. A. R.

3662. Analysis of the Radius Vectors of the Polar Motion. K. Ledersteger. *Gerlands Beitr. z. Geophys.* 26. 3. *pp.* 314–332, 1930.

With a progressive fractional development of the ratio of the annual to the Newcomb period the resonances shown in the radius vector r, of the polar track, or better in r^2, are discussed in detail. From these means of r^2, calculated on 1·1 years, the function r^2 is separated into two principal components. A period of about 25 years, visible in the curve for r^2, is connected with two periods differing little from the lengthened Eulerian notation and very similar to " Witting's perturbations." Their existence is confirmed by the 9- and 5-year periods resulting from the combination with the annual period. The short-period oscillations, eliminated by successive means, depend upon the distance of the undisturbed pole of inertia from the origin of co-ordinates and thus upon the combination of the observing stations, while their amplitude gives, in addition, data regarding movements of parts of the earth's crust. After elimination of the two main periods, their coefficients having been found by compensation according to the method of mean squares, the period of the lunar node can be shown quite well in the curve for the remainder vector and its maximum coincides with the longitude of 90° for the node. R. S. R.

3663. Seismic Waves, P′, from Records of New Zealand Earthquake of June 16, 1929. I. Lehmann. *Gerlands Beitr. z. Geophys.* 26. 4. *pp.* 402–412, 1930. *In English.*

The records of 58 stations have been examined for the P waves produced by the New Zealand earthquake of June 16, 1929. The ordinary P wave (P_n) is recorded as far as Pulkovo ($\Delta = 150\cdot 6°$), but is already faint at Sucrè (99·3°). The horizontal component of the first phase of P′ (Turner's [P]), $P_1'H$, is first observed at Tucson (102·3°), and thereafter at all reporting stations to Toledo (176·6°); the vertical component, $P_1'Z$, is less regularly reported from Irkutsk (110·8°) to Cartuja (174·4°). It is on the whole slightly earlier than $P_1'H$, and has approximately the same course as P′ in the tables of Gutenburg and Macelwane. The second phase, P_2', is recorded at most stations from Lund (160·5°) to Toledo (176·6°), its time-curve is given by $P_2' - T_0 = 20' \; 46'' + (\Delta - 160) \times 4\cdot 2''$. This is perhaps the second branch of P′ theoretically determined by Gutenburg. There being no stations between 137·4° and 149·0°, the sudden increase at 143° calculated by Gutenburg for P′ cannot be verified, though at 135° P′ is strong, and at 150° very strong; but a sudden increase from a negligible amplitude cannot occur. It is considered that the differences in the observed times for P′ in various earthquakes are not due to varying focal depths so much as to differences in observation. C. A. S.

3664. Seismicity of the Arctic. E. A. Hodgson. *Roy. Astron. Soc., Canada, J.* 24. *pp.* 201–210, *May–June,* 1930.

General and statistical notes. Milne estimated in 1907 that of 474 world-shaking earthquakes of the period 1899 to 1906 only 3 came from the Arctic Circle somewhere near Jan Mayen. The destructive earthquakes of Iceland, 1013 to 1899, he listed in 1911. In 1908 a seismic station was established at Reykjavik, which recorded, in 1910, 123 earthquakes, 68 of the shocks being the earthquake and aftershocks of January 22, 1910, and the following 24 hours. A station at Advento Bay, Spitsbergen, was in operation during the winter and spring of 1911–1912. Only the smaller of these earthquakes (not the larger tectonic shocks) seemed to be connected with volcanic action. The Dominion Observatory at Ottawa has deduced epicentres since 1911; the station is about 1600 km. from the Arctic Circle. For a period 1913 to 1925 there are also the seismological summaries of Turner. Nearly all the smaller earthquakes came from Iceland or Jan Mayen, the larger from the latter district; but there are further seismic areas off the mouth of the Lena river and north-east of the Mackenzie river. Ottawa and Oxford agree as to these locations, but most of the disturbances are short tremors of 5 or 10 min. at uncertain distances, and not reported by the daily Press at all. The Reykjavik station was reopened in 1926, and the Geodetic Institute of Denmark has established a first-class station at Copenhagen and a substation at Scoresby Sound, east coast of Greenland. A list of local earthquakes registered at Ottawa 1924 to 1929 is given. H. B.

3665. The Great Siberian Meteor and the Waves, Seismic and Aerial, Produced by It. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* 56. *pp.* 287–301; *Disc.,* 301–304, *July,* 1930.

Certain abnormal oscillations recorded by microbarographs at Cambridge, London, Petersfield and Reading between 5 and 6 a.m. on June 30, 1908, have been identified as due to the fall of the great Siberian meteorite at about 101° 18′ E., 61° N., or 950 km. west of north of Irkutsk. Disturbances (probably due to arrival of Raleigh waves) attributable to its impact were recorded by the seismographs at Irkutsk, Tashkent, Tiflis and Jena, whence the time of fall is deduced as 0 hr. 15 ± 0·5 min.

(G.M.T.) on June 30. The place of the fall was visited by Kulik in 1921, and showed an area of devastation about equal to that of Yorkshire, caused apparently by an enormous blast of air and heated gases spreading out from a central point, where was a crater-like valley, pitted with many "funnels." The velocity of the air waves that reached this country lies between 303 and 323 m./sec., and the total energy of all air waves is calculated as equal to that of the impact of a mass of 12 tons moving at 72 km./sec. Assuming that about 1/10th of the energy of impact went into the air waves, this agrees well with Kulik's estimate of 130 tons as the total mass of the meteorite. In the *Discussion* the occurrence of brilliant sky-glows on the nights following June 30 and July 1, 1908, and of peculiar appearances in the sky on June 30 were reported. It was also pointed out that the ordinary barogram at Greenwich indicated a disturbance at the right time. C. A. S.

3666. Geometrical Amplifiers. A. Belluigi. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 2. *pp.* 137–140, 1930.

A theoretical study of geometrical amplifiers of small deformations of electric current lines, deformations set up in a region artificially electrified. The conclusions can be applied to the interpretation of geoelectric problems. J. J. S.

3667. Phase Relations in the Potential Field in Geophysical Investigations. W. Heine. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 2. *pp.* 156–164, 1930.

The change of phase between two current lines in media of different electric conductivity depends on the absolute amounts of the specific resistance of the two media. The difference of the change of phase between current lines of 1 m. and 10 m. distance from the place of insertion increases to larger values only if one of the two media possesses a specific resistance of the order of magnitude of 10^5 to 10^6 ohms; with lower or higher values the phase difference remains very small. This agrees with experiment. The shift of phase due to the change of the current density on the middle perpendicular to the line joining the electrodes (null potential line) is approximately calculated. J. J. S.

3668. Changes of Rock Temperatures and Irregularities of the Earth's Rotation. R. W. Wrigley. *Roy. Soc. Edinburgh, Proc.* 50. 2. *pp.* 153–165, 1929–1930.

The records of temperatures at Calton Hill, Edinburgh, at depths of 6·4, 12·8 and 25·6 ft., and of 5, 11, and 21 ft. for the years 1838–1876 and 1880–1929, respectively, and those at Greenwich at a depth of 25·6 ft. for 1868–1910, are examined. After elimination of surface influences, it is concluded that there is a genuine residuum of changes due to deep-seated causes. These are shown to correspond more closely than can be due to coincidence with the " minor fluctuations " of the moon's motion. Possible explanations in the shape of crustal, etc., movements are discussed, but no definite explanation arrived at. C. A. S.

3669. Effect of Temperature Distribution on the Deformation of a Semi-Infinite Elastic Body. G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 8. *pp.* 91–141, *June*, 1930.

Obtains the general equations of equilibrium, when variations of temperature occur, and deals with the two dimensional and the three dimensional problems. Some examples have been solved by using Fourier's double integral formula; a number of curves are plotted to show how the normal strain and the surface inclination vary under different conditions of temperature distribution in the interior of the solid. Even if the temperature changes suddenly in proceeding from one point to another the surface deformation is moderate. H. N. A.

3670. Photographic-Photometric Study of the Zodiacal Light. R. Müller. *Zeits. f. Astrophysik,* 1. 1. *pp.* 35–42, 1930.

Photographs of the Zodiacal Light were taken in the German low-latitude mountain station of La Paz, Bolivia, and the distribution of intensity was measured with a Hartmann photometer. The axis does not lie in the ecliptic, as generally believed. A series of photographs, taken both morning and evening during the course of a year, in a low-latitude station, would probably solve the problem of this phenomenon. M. A. E.

3671. Change in Wave-Length of Fraunhofer Lines Across the Sun's Surface. E. F. Freundlich, A. v. Brunn and H. Brück. *Zeits. f. Astrophysik,* 1. 1. *pp.* 43–57, 1930.

Gives the results of measurements made with the grating spectrograph and telescope at the Einstein Tower of a particularly sharp iron multiplet in the sun's spectrum for 72 places on the surface compared with a spot near the centre. The variations of wave-length along different radii are discussed, and a normal curve deduced of the so-called "edge effect." F. S.

3672. Scattering in the Earth's Atmosphere and the Structure of Fraunhofer Lines. H. Brück. *Zeits. f. Astrophysik,* 1. 1. *pp.* 58–65, 1930.

The structure of some Fraunhofer lines has been studied which were obtained on plates taken during a partial eclipse of the sun, with reference to their variation with time. Light from a point of the uneclipsed part was also considered. The variations show the same magnitude and similar form for both parts of the surface. It is deduced that there is a real alteration in the absorption of the sun's atmosphere, and that scattering in the earth's atmosphere plays only a subordinate part. F. S.

3673. Interpretation of the Spectrum of the Solar Corona. A. H. Rosenthal. *Zeits. f. Astrophysik,* 1. 2. *pp.* 115–137, 1930.

It is shown that the emission lines of the coronal spectrum may possibly be interpreted as due to the lines of a helium atom of which the inner electron is on a 2 s-level (instead of the 1 s-level of a normal helium atom), while the other electron is passing from one of the outer levels to another. A series of strong coronal lines harmonises with this hypothesis, for these lines bear a definite relation to certain lines of the normal helium spectrum, and the intensities also correspond. The continuous spectrum of the corona is also discussed, and the attempt is made to apply one interpretation to both. M. A. E.

3674. Wave-Length of H_ϵ and Displacements of Hydrogen Lines in the Sun. J. Evershed. *Roy. Astron. Soc., M.N.* 90. *pp.* 762–764, *June,* 1930.

In 34 prominence plates giving good images of H_ϵ, the interval between this line and the calcium line H has been measured, and the mean interval found is 1·607 Å., with a probable error of ± 0·0008 Å. The wave-length of H in air and at zero pressure has been determined as equal to 3968·469, hence the wave-length of H_ϵ under similar conditions is 3970·076. From this value the wave-lengths of H_δ and H_γ have been computed by means of Balmer's formula, and adding the wave-lengths found by Curtis for H_β and H_α, these five hydrogen lines are compared with the solar absorption lines given in the Revision of Rowland's Table. The shift of H_γ is nearly in agreement with the Einstein effect, in H_ϵ it is less, and in H_α very much greater. Since H_γ represents an intermediate level in the chromosphere, H_ϵ a low level, and H_α a high level, the difference in shift can readily be explained by postulating a descending motion of about 0·4 km./sec. in the higher levels of the chromosphere, decreasing to zero at an intermediate level, and changing to a slight ascending motion at the level of H_ϵ. St. John finds, in lines of the reversing layer, indications of a similar ascending and descending movement. M. A. E.

3675. Neptune's Orbit. J. Jackson. *Roy. Astron. Soc., M.N.* 90. *pp.* 728–732, *June*, 1930.

By a simple change of elements, Lalande's observations in 1795 can be satisfied very closely with the modern observations. The author gives a table of the corrections which reduce Leverrier's tables to Newcomb's and analyses the residuals in the form $\alpha + \beta t + \gamma \cos g + \delta \sin g$, obtaining the values, $\alpha = -1''{\cdot}60$; $\beta = -1''{\cdot}64$ (meaning an increase in the period of about 3 hours); $\gamma = +1''{\cdot}73$; $\delta = -0''{\cdot}02$. Tables show the residuals as analysed, the corrections required by the above elements and the final residuals from 1795–1928; the corrections to Newcomb's tables for the next 20 years; and the results of the Greenwich observations from 1898 to 1929. The author compares them with Leverrier's residuals of Uranus between 1781 and 1845, when the relations of Uranus and Neptune were fairly similar to those of Neptune and the new object between 1795 and 1930. He concludes that there is no body more massive than one-twentieth of Neptune near the new object's position; that the mass of this may be taken as less than that of the earth and not greater than would be obtained by giving it the lowest albedo and the highest density of the major planets; when its orbit is more definitely known its mass can be deduced from Neptune's perturbations, but will not exceed, probably, its probable error.
A. S. D. M.

3676. Orbit of the Trans-Neptunian Body Discovered at Lowell Observatory. N. Stoyko. *Comptes Rendus*, 190. *pp.* 1275–1277, *June* 2, 1930.

Elements of the orbit of the trans-Neptunian planet are calculated from observations taken March 16 and April 1, 1926. The lower limit of eccentricity of the orbit is found to be 0·407; its actual value is still unsettled. [See also following Abstract.] J. S. G. T.

3677. Influence of 3rd and 4th Order Terms in Using Esclangon's Method to Determine a Planet's Orbit. Application to the Trans-Neptunian Planet. N. Stoyko. *Comptes Rendus*, 190. pp. 1379–1381, *June* 16, 1930.

In taking account of the 3rd order derivatives in the expression for the heliocentric coordinates, three values for θ are inserted in the fundamental equations, and these used to obtain measurements of the orbit. They were applied to observations made on an unknown planet at Uccle in 1927. Subsequently, using the values found at the Lowell Observatory, a recalculation was made and differences found. **E. Esclangon** [*ibid.*, 1381–1382], in his remarks, refers to the accuracy of values for the distance and the node of the planet, but doubt exists regarding the eccentricity, semi-major axis and time of revolution which may require a long time to verify. [See Abstract 3370 (1930) and preceding Abstract.] R. S. R.

3678. Determination of the Orbit of a Star (Planet or Comet) by Three Observations, Allowing for Perturbations Caused by Other Planets. E. Esclangon. *Comptes Rendus*, 190. *pp.* 1469–1472, *June* 23, 1930.

The author shows that the mathematical analysis employed formerly for the calculation of the orbit when the orbit was purely Keplerian applies also when account is taken of perturbations produced by other planets. [See Abstract 3370 (1930).] R. S. R.

3679. Calculation of Planetary Perturbations Using a New Independent Variable. (Mme.) N. Samoïlowa - Jachontowa. *Comptes Rendus*, 190. *pp.* 1544–1546, *June* 30, 1930.

A new method is here developed, and as an example of the results obtainable the perturbations of longitude in an orbit corresponding with that of Thule are given, and are compared with those obtained by Brendel with his new method. The paper is purely mathematical. M. A. E.

3680. Contours of Hydrogen Lines in Stellar Spectra. C. T. Elvey. *Astrophys. J.* 71. *pp.* 191–208, *April*, 1930.

The contours of the hydrogen lines $H\beta$ and $H\gamma$ have been determined for sixty-four stars, mostly of spectral types earlier than Fo. The residual intensities and the widths of the lines of the early type stars are greater than for the lines of the same total intensity in later types. This is interpreted as the result of the Stark effect. The excess widths of the lines are correlated with the absolute magnitudes of the stars. Another correlation with the absolute magnitudes is the ratio of the width of the line to its depth. The correlations are used to determine the absolute magnitudes of several stars. The effective numbers of atoms producing the absorption lines are determined and compared with Milne's application of the theory of thermal ionisation to a stellar atmosphere. The observations are not in accordance with the theory in its present form. The observations show an absolute-magnitude effect for stars at temperatures higher than that of maximum, which is in contradiction to the " null effect " of Milne. In a note added to the paper the suggestion of Gaunt [see Abstract 3409 (1930)] that the coefficient of absorption varies with the temperature as $P/T^{3/2}$, instead of as $P/T^{9/2}$, which is used in Milne's formula, gives a theoretical curve for the variation of the number of atoms with the temperature which is in much better agreement with the observations. AUTHOR.

3681. Band Spectrum of He_2 in Stellar Spectra. O. Struve and A. Christy. *Astrophys. J.* 71. *pp.* 277–282, *May*, 1930.

Under certain conditions in the discharge tube, the band spectrum of He_2 is found associated with the line spectrum of He_1. The spectrum of 88γ Pegasi has been investigated, but the same is found not to hold good. This is in accordance with theory, as in the case of stars only a very small percentage of atoms would be expected in the molecular state. F. S.

3682. Behaviour of Bright Lines in Long-Period Variable Star Spectra. P. W. Merrill and Cora G. Burwell. *Mt. Wilson Observat. Contrib. No.* 399. *Astrophys. J.* 71. *pp.* 285–335, *June*, 1930.

A study of the intensities of the bright lines in the blue-violet region of the spectra of 10 Me and 3 Se stars, using ratios of the intensities of the lines, $H_\gamma : H_\delta$ (which varies in phase in a striking manner); $H_\beta : H_\gamma$; λ4308 : λ4202; and λ4571 : λ4308. In this last ratio the low-temperature Mg. line λ4571 is the last conspicuous bright line to appear after maximum in each cycle, but becomes the most intense near minimum. The forbidden lines of ionised Fe are once seen in U Orionis, and regularly in R Leonis towards minimum, but emission requires the ionisation of Fe atoms and their increase in intensity as the star grows cooler is strange; they occur paradoxically in these spectra together with the extreme low-temperature lines of neutral Fe and λ4571 of Mg. Perhaps the forbidden lines occurring before minimum are connected (compare the behaviour of sunspots) with the beginning of a new cycle. In X Cygni the spectrum is both M and S, indicating very low density. A table gives the apparent velocities from the blue-violet lines and shows algebraically decreasing velocity at and after light-maximum, and a flat minimum from 30 to 80 days after it. Absorption lines and bands show single relationship to rise and fall of temperature of photosphere and reversing layer, with phase, but not so the emission lines. Titanium oxide seems to rise to very high levels in M and S stars above the hydrogen emission lines and modifying these by absorption. A. D. S. M.

3683. Spectrographic Study of U Sagittae. A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 401. *Astrophys. J.* 71. *pp.* 336–350, *June*, 1930.

A study with the 60-in. and 100-in. reflectors of this eclipsing binary, of which the brighter star is B_9 and the larger and fainter star is G_2; this is alone visible during totality, which lasts 100 minutes, and the relative masses may be determined. During the partial phase the velocities are affected by rotation, and it was desired to obtain direct observational evidence on the question of darkening at the limb of an early-type star. The corresponding rotation effects for the uniform and darkened discs were estimated as 60 km./sec. and 62 km./sec., the uniform being in better agreement with the photometric observations. The absolute dimensions and physical properties on the two hypotheses of uniform and darkened limbs are: semi-major axis of primary orbit, 3,169,000 and 3,155,000 km.; of secondary orbit, 10,457,000 and 10,410,000 km.; radius of G_2 star, $5\cdot7 \odot$ and $5\cdot4 \odot$; of B_9 star, $3\cdot4 \odot$ and $4\cdot2 \odot$; density of G_2, $0\cdot011 \odot$ and $0\cdot013 \odot$; of B_9, $0\cdot171 \odot$ and $0\cdot090 \odot$; visual absolute magnitude of G_2 $+ 1\cdot8$ and $+ 1\cdot9$; of B_9, $- 0\cdot4$ and $- 0\cdot8$. The absolute magnitude and masses satisfy the mass-luminosity correlation of Eddington very closely, and the parallax is found to be $0''\cdot003$. A. S. D. M.

3684. Star Streaming in Relation to Spectral Type. W. M. Smart. *Roy. Astrom. Soc., M.N.* 90. *pp.* 743–749, *June*, 1930.

A study of the spectral types of Group I [see Abstract 944 (1927)] with respect to streaming. Ilford panchromatic plates were taken of the four regions, four exposures being through a Wratten blue filter and two through a yellow. The author describes how the colour-indices of the individual stars are got, and gives diagrams of the relations between star diameters and exposures for the two screens. The three sub-groups of Group I can thus be classified as (i) B, A, F or white stars, (ii) G–K_5 or intermediate, (iii) K_5–M or red stars, containing respectively 159, 174 and 167 stars. Frequency curves are given, the scales being chosen so as to give each diagram the same total number of stars. The white and intermediate give curves similar to that given by all the stars, but the red stars show a separation into two distinctive groupings of which the most prominent is roughly in the ant-apex direction and has a more lateral spread than Drift I should have. This, as Oort has shown, is due to the preponderance of high-velocity stars in M-type dwarfs, for the effect of these stars is small in the white and intermediate sub-groups. A. S. D. M.

3685. Effects of Band Spectra on Stellar Magnitudes and Colours. Cecilia H. Payne and P. ten Bruggencate. *Harvard Coll. Obs., Bull. No.* 876. *pp.* 1–7, *June* 1, 1930.

Titanium oxide bands in M stars and carbon and cyanogen bands in N stars are effective in cutting down, respectively, the red and violet ends of the spectra, making them bluer and redder, and in both cases diminishing the photographic and visual brightness. Their great strength and rapid change of intensity with small change of temperature are due to the greater total absorbing power of a given number of absorbing molecules over the same number of atoms. The authors thus account for the ranges, visual, photographic and radiometric, of long period variables of both M and S classes, taking Mira as an example of the M stars; the colour changes of M and N variables; M stars are no redder at maximum than at minimum as the cutting down of the red end is compensated by increased redness due to lowered temperature, and for the same reason show no colour progress with period; N stars are reddest at minimum since their violet end is cut down; the tendency of M and N stars to vary irregularly may be due to small changes in the surface conditions, causing a change in the number of molecules, and therefore in the effectiveness of absorption bands. A. S. D. M.

3686. Photographic Light-Curves of Cepheid Variables. Parts IV and V. L. V. Robinson. *Harvard Coll. Obs., Bull. No.* 876. *pp.* 18–28, *June* 1, 1930.

Following the suggested classification into four groups, which was made in a previous paper [see Abstract 2116 (1930)], special investigation has been made of ten typical δ-Cepheid variables with periods longer than one day but shorter than nine days (Ludendorff's Group II). Tables, light-curves and notes are given for each of these stars. Investigation of the brighter stars in the International List is also continued, and light-curves have been derived for eight stars in Fields 4 to 7. Five of these show variations in spectral type and colour, accompanying the variations in light. M. A. E.

3687. Structure of the Local Star Cluster. Part I. Spectral Types A to K in Zone−60°. F. Becker. *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 174–188, 1930.

The spectral classification of faint stars in Kapteyn selected areas of southern declination, now being carried on at Potsdam Observatory, yields useful material for the study of the nearer stars, which form what is known as the local cluster. The plates were taken by the German expedition to Bolivia, and include spectra of stars down to the 12th magnitude—that is, stars with a mean distance three or four times as great as any classified hitherto. In the preliminary results now presented, magnitudes were merely estimated from the spectra, and only the classes A, F, G and K in one zone are discussed. M stars are too few, and B stars scarcely occur except in two fields; they will be studied in another connection. The distribution of every sub-type of these four spectral classes in each of eight southern fields is shown in a diagram; and it is clear that, although there are local condensations, galactic latitude is the chief factor in determining the frequency, especially with the A stars. The distribution according to magnitude (practically equal to distance) is also shown, and the number of A stars falls so rapidly at about magnitude 11·5, that it is evident the local cluster comes to an end at this distance as far as A stars are concerned. F stars show a sudden drop in numbers at magnitude 11 in the field − 26°, which perhaps indicates the presence of an obscuring cloud. To find the real from the apparent distribution, an absolute magnitude corresponding with its photographic magnitude has been assigned to each star, calculated from the mean absolute magnitude and mean colour index of each spectral type. The distance has then been reckoned in the usual way from the assumed absolute magnitude, and the number of stars per unit volume of space (10,000 cubic parsecs) at different distances from the sun is deduced. A and F stars tend to decrease in density with increasing distance, though local condensations occur, but the density of G stars varies irregularly. There are on the whole three F stars to one A, and 12 G stars to one F. These figures agree fairly well with those found by Shapley for the whole galaxy. M. A. E.

3688. Deviations from Thermodynamic Equilibrium in Stellar Atmospheres. A. Unsöld. *Zeits. f. Astrophysik,* 1. 1. *pp.* 1–12, 1930.

According to Adams and Russell [see Abstract 90 (1930)] the relative number of highly excited atoms in the cooler stars compared with the hotter is much greater than was to be expected from the Boltzmann formula, indicating serious deviations from thermodynamic equilibrium. The author finds that the same anomaly affects ionisation. The explanation may be that radiation in the short wave-lengths of the ultra-violet increases more rapidly in energy than it does theoretically with a black body of stellar temperature. The curve of excitation calculated according to this theory (universal Boltzmann factor) is compared with an empirical curve derived from observation of excitation and ionisation. The empirical deviations from thermodynamic equilibrium are of the same order as the calculated, and it is satisfactory to find that excitation and ionisation show the same deviation quantitatively. An important conclusion is that the number of hydrogen atoms calculated on the basis of the Boltzmann factor for the cooler stars is much too high, and the partial pressure of free electrons calculated by means of Saha's formula is much too low. M. A. E.

3689. Effective Temperatures of Stars. R. A. Sampson. *Roy. Astron. Soc., M.N.* 90. *pp.* 636–667, *May,* 1930.

The effective temperatures of 80 stars, for the most part giants of high luminosity, are given. The intensity of the light of a given wave-length is estimated by the depth of the photographic deposit for the star considered and the star Polaris as reference star. From the curve of relative intensity for all wave-lengths the temperature of the star can be deduced in terms of that of Polaris. The temperature of Polaris is taken to be 6500° Abs. and the temperatures of the other stars follow on this basis. The classification of the stars according to their temperatures, determined in this way, is compared with the classification according to their spectra, and the agreement is found to be good. The temperatures found range from 3700° to 20,000° Abs. G. C. McV.

3690. Masses, Luminosities and Effective Temperatures of Stars. Second Paper. E. A. Milne. *Roy. Astron. Soc., M.N.* 90. *pp.* 678–689, *May*, 1930.

In reply to Eddington's criticisms [see Abstract 2121 (1930)] of the author's theory of the possible relative density distributions in a star of prescribed mass M, generating energy at a prescribed rate L, the author shows that his solution, in the case of a star of perfect gas, reduces to Eddington's when β (the ratio of radiation to total pressure) and μ (the molecular weight) are taken to be constants. The solution when β and μ are not constant and the solution when the star is not composed of perfect gas are also discussed shortly. From photospheric investigations the boundary of the star in these solutions may safely be taken to be the depth at which the actual temperature is equal to the effective temperature.

G. C. McV.

3691. Distribution of Luminosity in Elliptical Nebulæ. E. Hubble. *Astrophys. J.* 71. *pp.* 231–276, *May*, 1930.

The sequence of elliptical nebulæ ranges from round images to a lenticular form with a ratio of axes, 1 to 3, whose luminosity distribution is very uniform; nebulæ with lesser ellipticities and of a given degree of flattening also are uniform when orientation effects are eliminated. The author gives the measures and reductions for N.G.C. 3379 (an Eo nebula), and derives a characteristic absorption curve for Eastman 40 plates exposed to sunlight. The central part of this is linear and can be represented by $\log I = 1\cdot058\ A + \text{constant}$, and for the luminosity curves of 15 elliptical nebulæ the formula is obtained by $\log I = \log I_0 - 2 \log (r + a)a^{-1}$; where log I is the surface brightness and is independent of the micrometer slit, $\log I_0$ is a measured absorption of about 0·116, which is well above the threshold of the plates, a is distance from nucleus where luminosity falls to $I_0/4$ and is a measure of the luminosity gradient, and r is the distance from the nucleus; this formula is also tested by comparing the measured diameters with those computed from $\log I_0$ and the constant threshold value of log I. A diagram is given of the relation between central luminosity and diameter. The correlation between diameters and exposure times suggests that the longest exposures have not reached the nebulæ boundaries. The luminosity curves along the minor axis are steeper than in the inner region. The absolute luminosities are of about the right order of magnitude. Absorption of light is inappreciable. There are highly concentrated nuclei, and in the outer regions luminosity falls off faster than the density.

A. S. D. M.

3692. New Determination of Constant of Nutation. J. Jackson. *Roy. Astron. Soc., M.N.* 90. *pp.* 733–742, *June*, 1930.

The author uses for this purpose the 19 years' observations with the Cookson floating telescope for latitude determination at Greenwich. These were made after sunset and before sunrise, so that stars were observed, on the same night, of quite different right ascensions, and the differences of their observed zenith distances can be used independently of latitude. He describes the observed data and the corrections for proper motion, scale value and temperature, as well as those (like aberration) which have a long period and one not much different from a year. He obtains the result, $9''\cdot2066 \pm 0''\cdot0055$, as compared with Newcomb's $9''\cdot210 \pm 0''\cdot008$ and Przybyllok's $9''\cdot207 \pm 0''\cdot003$. Combining these, the value may be taken as $9''\cdot2075 \pm 0''\cdot002$. He considers its relation to other fundamental constants. Fotheringham has shown that the relativity effect on precession has been applied with the wrong sign, and therefore the theoretical value of the nutation constant based on Newcomb's value of precession and the mass of the moon is 9″·218 (or, with Oort's correction, 9″·220), not 9″·210; the observed value differs from this by about 6 times its probable error, so that this is one of the outstanding discordances in the constants of the solar system. A. S. D. M.

3693. Variable Star η Aquilæ. G. Tiercy. *Archives des Sciences,* 12. *pp.* 179–201, *May–June,* 1930.

Ten plates were taken at Arcetri by Abetti and nineteen by the author. Prager's elements are used; the method is as in previous memoirs [see Abstracts 2647 and 2967 (1928)]; the measures in the two series are brought into accord by means of 5th magnitude invariable stars; all the plates except two are of "Capelli-blu" make. The light curves indicate a secondary undulation a little before minimum light which has confirmation from Hornig, Luizet, Nijland, Wylie and Kohlschütter, but not from van der Bilt, E. Pickering, Lau, Schur and Terkan. The mean radius is 15·1 R_s(R_s = 696,000 km.) and varies from 13,435,968 km. at phase $3^d\cdot44$ to 10,201,843 km. at $6^d\cdot72$; the curve of pulsation is not quite symmetrical but more regular than the light curve. The mean colour index, $I_m = 0\cdot57$; $I_{\max.}$ is 0·872 at phase $4^d\cdot3$; $I_{\min.}$ is 0·273 at $6^d\cdot950$. The mean pressure P_1 is about 0·0035 atm.; the least pressure (0·000977 atm.) is near $I_{\max.}$, and the greatest (0·003807 atm.) is near $I_{\min.}$ A. S. D. M.

3694. Rotation of Stars and the Contours of Mg⁺ 4481. C. T. Elvey. *Astrophys. J.* 71. *pp.* 221–230, *May,* 1930.

The effect of axial rotation of a star on the contours of the Mg^+ 4481 line is computed by a graphical method. The calculated contours are compared with those observed in fifty-nine stars of spectral classes O, B, A and F. The average value of the velocity of rotation, corrected for the average inclination of the axis to the line of sight but not for darkening at the limb, is 60 km./sec. for these stars. The total absorptions of the lines indicate that the maximum of Mg^+ 4481 is in a subdivision later than A2, the assigned spectral class. Provisionally, the maximum is placed at class A5. AUTHOR.

3695. Galactic Rotation. B. J. Bok. *Harvard Coll. Obs., Bull. No.* 876. *pp.* 8–14, *June* 1, 1930.

A study of Mineur's contentions that the local cluster rotates round its centre in Carina and that the centre of galactic rotation may not be at $l_0 = 325°$ [see Abstract 2786 (1930)]. Mineur's results, in his first contention, depend on the accuracy with which his formula, $A\alpha^2 + B\beta^2 + C\gamma^2 + 2A'\beta\gamma + 2B'\gamma\alpha + 2C'\alpha\beta = 0$, represents the observations, and the author shows by a comparison of the values of rotation coefficients with their mean errors that his conclusion is uncertain. In the second contention [see Abstract 3087 (1930)] Mineur's conclusion is correct as far as radial velocities are concerned, but he neglects the evidence from proper motions in which the *sign* is without doubt [see Abstract 2785 (1930)], though the amount may be uncertain. The combination of the evidence for galactic rotation from both radial velocities and proper motions yields a dynamically possible rotation if Oort's centre, $l_0 = 325°$, is adopted. A. S. D. M.

LIGHT.

3696. Complete Colour System. K. Miescher. *Zeits. f. techn. Physik,* 11. 7. *pp.* 233–239, 1930.

The trichromatic coordinates, according to Ives, of the complete colours are derived and a new formula set up for the reciprocal transformation between trichromatic and complete colour coordinates. Supersaturated and very pale colours, the so-called Ostwald false colours, form with remission colours an exception. It is shown that their saturation and relative brightness exceed unity and that their white compared with their black content is negative. The complete colour coordinates of the Ostwald cross colours can serve now for the direct measurement of the colour according to the theoretical complete colour system with the help of a step photometer. An agreement with calculation for the coordinates of yellow still requires an explanation. The misunderstanding of the judgment of the complete colour system is shown as the cause for the deficient distinction between the theoretical complete colour coordinates and the Ostwald filter values. [See Abstract 872 (1928).] R. S. R.

3697. Experiments in Mobile Colour. G. A. Shook. *J.O.S.A.* 20. *pp.* 354–361, *June,* 1930.

The original idea of a melody in colour was an analogy between the colour and a musical note—that is, rhythm, melody and colour harmony. Now the modern mobile colour artist is attempting to obtain form, motion and colour harmony rather than the musical analogy. The present author describes a number of different types of colour organs developed by him and indicates the effects produced on the screen and on audiences. The ideal colour organ is briefly discussed, considering previously described colour organs, and the problem of this ideal, manually-operated, colour organ is shown to be a mechanical one, capable of solution when demand arises. R. C. F.

3698. Mathematical Representation of Sensibility to Difference of Colour. R. A. Houstoun. *Phil. Mag.* 9. *pp.* 1130–1144, *June,* 1930.

Theories of colour perception, due to Helmholtz and to Schrödinger, are critically examined. The author considers that one of the three variables defining colour sensation should represent brightness alone. A discussion of experimental results obtained by Steindler, Jones and Lowry leads to the conclusion that if one of the three primary sensations is to specify brightness and the other two colour, it would involve the least disturbance of current practice if the sensations taken were $R + G + B$, $R'/(R' + G' + B')$ and $G'/(R' + G' + B')$, where R, G and B are the Young-Helmholtz fundamental sensations, expressed in units of equal luminosity, whilst the accented symbols represent the same sensations in units, equal quantities of which make white. Polar coordinates are indicated for the representation of sensibility to colour differences. J. S. G. T.

3699. Artificial Colour Blindness. N. T. Fedorow and V. I. Fedorowa. *Zeits. f. Physik,* 62. 11–12. *pp.* 834–841, 1930.

An investigation of the rate at which an eye exposed to intense red light recovers its capacity for seeing red. The rate of recovery is gauged by measuring the minimum quantity of red light ($\lambda = 670\ m\mu$) required to be added to green light ($\lambda = 530\ m\mu$) in order that the colour should be equal to that of the yellow sodium line. The authors obtain results agreeing with those obtained by means of Goldberg's spectrodensograph, but are unable to decide whether the chemical reaction which restores the red sensation is monomolecular or bimolecular. E. E. F. d'A.

3700. Double Monochromator for Ultra-Violet Light. G. Bruhat. *Rev. d'Optique*, 9. *pp.* 193–202, *May*, 1930.

The apparatus described is constructed according to the design of van Cittert, this being most free from stray light and the most convenient to handle. Cornu quartz prisms are used and quartz-water objectives. The latter are used free from spherical aberration while they were calculated to be achromatic for 3404 and 2313 Å. and were sufficiently achromatic over the required region 3663–2378 Å. but useless for the visible spectrum. With a polarimeter mounting of the Bruhat-Pauthenier type the apparatus forms a spectro-polarimeter having a characteristic band of 24 Å. for a wave-length of 2537 Å. R. S. R.

3701. Chromolinoscope. H. E. Ives. *J.O.S.A.* 20. *pp.* 343–353, *June*, 1930.

Describes an instrument invented and constructed many years ago by F. E. Ives, which is apparently the first attempt to use an optical system incorporating three coloured light sources and a mosaic of refracting ridges, such as is used in the " Kodacolor " process. The differences between the two methods are briefly discussed, and a new design of chromolinoscope described which is suitable for use with the " Kodacolor " film, only single pictures being viewed. If original films only can be used then the instrument is very restricted, but to remove this restriction, methods of making suitable pictures from the original are described. Two methods are given for making ridged film pictures from the usual three-colour " separation " negatives, whilst a third method is described which is suitable for copying from ridged film to ridged film. R. C. F.

3702. Physical Properties of Glasses in Relation to Their Composition. Transparency of Glasses in the Ultra-Violet, Visible and Infra-Red. M. Fritz-Schmidt, G. Gehlhoff and M. Thomas. *Zeits. f. techn. Physik*, 11. 8. *pp.* 289–326, 1930.

The influence on the transparency of glasses of the addition of the customary glass-forming and colouring oxides is investigated systematically over the range of wave-lengths $0{\cdot}2 - 5\mu$. The basis is a melt of 82 % SiO_2 with 18 % Na_2O, in which the SiO_2 is progressively replaced by another glass-forming oxide. The influence of alkali is investigated separately, starting from melts containing 80 % SiO_2 + alkali oxide and 20 % B_2O_3 or PbO. A series of four component glasses were employed for determining the effect of substituting potash for soda. Chemically pure substances were used throughout, and special precautions were taken to prevent contamination. Curves are given showing completely the results of the measurements, and from these it is possible to derive the constitution of glasses of widely differing transparencies and colour.

C. B. A.

3703. Optical Altimeters in Monostatic Telemetry. A. de Gramont. *Rev. d'Optique*, 9. *pp.* 203–223, *May*, 1930.

The monostatic alti-telemeter measures simultaneously the altitude and distance of the object in the air, but new methods of firing require the altitude only, sometimes the horizontal distance. The altitude can be found directly by optical methods employing deviating systems. The author reviews the optical arrangements used in older types to obtain the distance of an object and lays down the aims to be sought in an ideal type. He discusses the application of these aims in the existing types devised by Barr and Stroud, Rottenburg and Willans, San Giorgio and Zeiss and the unusual devices employed by them. Finally the solution, which the author has studied with R. Petit, is given and has been confirmed by experience. R. S. R.

3704. Hurault Spherometer for Spherical and Non-Spherical Surfaces. *Rev. d'Optique*, 9. *pp.* 224–229, *May*, 1930.

After enumerating the objections to the usual types of spherometer a new type of instrument is described having many uses and serving also as a spherometer. It makes possible a methodical examination of different meridional sections of the surface to be tested. The construction of the instrument, its method of use and probable errors in the measurements are described. R. S. R.

3705. Validity of the Interference Method for the Measurement of the Specific Area of a Copper Surface. F. J. Wilkins. *Chem. Soc., J. pp.* 1304–1309, *June*, 1930.

It is shown that, when Constable's interference method for the measurement of the specific area of a surface is applied to oxide films on copper which has not been activated, the values obtained for the ratio (A) of the specific to the apparent area are anomalous in that they are always less than unity. Further, A is not a constant for a given surface but increases with the thickness of the oxide film and the temperature of oxidation. Activation of a copper surface by oxidation and reduction gives values of A which are greater than unity but which are still dependent upon the temperature of oxidation. It is suggested that these results may be explained by assuming that the oxide film contains unchanged metallic occlusions, the proportion of unchanged metal to oxide varying with the conditions and extent of oxidation. Experimental evidence is brought forward in favour of this interpretation. F. J. W.

3706. Production of Photometric Scales by Objective Prism Examinations. H. Kienle. *Zeits. f. Astrophysik*, 1. 1. *pp.* 13–34, 1930.

Discusses the conditions which must be observed in spectrophotometry using the prism camera developed for astronomical purposes. An arrangement is then fully described whereby photographic-photometric comparison spectra can be produced which have none of the objections usually present in comparison spectra. Finally, the methods of standardising the apparatus are described and an examination of its utility is given. R. C. F.

3707. Homochromatic Spectrophotometry in the Ultra-Violet. G. R. Harrison and P. A. Leighton. *J.O.S.A.* 20. *pp.* 313–330, *June*, 1930.

The *d*-log *t* curves of typical fast, medium and slow emulsions when coated with oils fluorescing in the blue, near and far ultra-violet respectively have been studied in the region 900–5000 Å. by both a vacuum and an ordinary quartz spectrograph. The reciprocity and intermittency failures of the same emulsions unoiled and when coated with the three oils have been studied in the region 2300–5000 Å. The results obtained enable it to be assumed that the reciprocity law throughout the Schumann region holds good when oil-emulsion combinations are used, which have been found to obey that law at the fluorescence maxima, thus the bulk of the secondary problems of photometric photometry are transferred from this difficult region to the near ultra-violet or visible. J. G. H. B.

3708. Parallax Panoramagrams Made with a Large Diameter Lens. H. E. Ives. *J.O.S.A.* 20. *pp.* 332–342, *June*, 1930.

The present method is an improvement on a former method [see Abstract 1162 (1929)], the motion of the lens being avoided and the camera having no moving parts. A photographic lens of diameter large compared with the distance between the eyes is used and an image is projected through a grating on to a plate close to the grating. In viewing the sensitive film is reversed and put on the side nearer to the eye with the screen behind and at the same distance from the film as before. The grating is viewed through the picture to get a stereoscopic view and eliminate the pseudoscopic one. Diagrams show the paths of light when taking and viewing the picture. Satisfactory results were obtained with a 24-in. f/2 lens, a grating of 50 lines to the inch, having opaque spacing ratio 10 : 1, the lens 4 ft. from the plate and grating and plate $\frac{1}{12}$ in. apart. The advantages and disadvantages of the method are discussed. R. S. R.

3709. Sensitometric Study of a New Panchromatic Plate. N. G. Perrakis. *Comptes Rendus*, 190. *pp.* 1493–1495, *June* 23, 1930.

The description of a study made from the particular aspect of the solar corona recorded on the Guilleminot panchromatic plate by the Strasburg mission during the total eclipse of the sun on May 9, 1929. The experimental arrangement is described and the results given, together with a table giving the length of the wave λ and the corresponding "factor of contrast" γ. The value of γ is about unity for $\lambda = 4000$ Å.; 2 when $\lambda = 4300$ Å., and increases slowly up to 6200 Å. when its value is about 3. There is a rapid increase up to 6800 Å. when it equals 5, after which it decreases with an equal rapidity till when $\lambda = 7150$ Å., γ is only 2·6. This explains well the fine structure of the corona jets which are seen on the photographs of the solar corona obtained by Lallemand. T. C. H.

3710. Polarisation of Sensitised Fuorescence. A. C. G. Mitchell. *Frank. Inst., J.* 209. *pp.* 747–756, *June*, 1930.

Refers first to previous work on polarisation of resonance radiation in magnetic fields of Cd, Hg and Na vapours [see Abstracts 2507 (1927) and 3020 (1929)]. Shows that the results can only be completely covered by the application of the quantum theory of the Zeeman effect. Then referring to experiments on electron excitation of mercury vapour [see Abstracts 1718 and 2022 (1927)], points out that the results indicate that the polarisation observed follows from the principle that the component of the angular momentum parallel to the field cannot change as a result of the collisions. The object of the present work is to extend the above experiments to the problem of the carrying over of polarisation on collision between two atoms. A discussion is given on the lines of the above principle as to the results to be expected from a mercury cadmium mixture excited by a narrow beam of mercury radiation in which the electric vector could be considered perpendicular to the beam and the field. The results obtained with this arrangement were that at a pressure of 0·5 mm. of cadmium, of mercury vapour 0·001 m. and He 2 mm. (He put in to prevent rapid diffusion), the Cd line 3261 Å. showed no polarisation, while the Hg line 2537 Å. does. This leads to the conclusion that polarisation is not carried over in collisions. J. E.

3711. Action of Boric Acid on the Phosphorescence of Zinc Sulphide Prepared by the Explosion Method. F. Prevet. *Comptes Rendus*, 190. *pp.* 1402–1403, *June* 16, 1930.

The incorporation of boric acid leads to an increase in the intensity, persistence and permanence of the phosphorescence of zinc sulphide prepared by the explosion method. Other substances, fused silica, alkaline silicates, alkaline chlorides and sulphates, were substituted in the powdered form, in place of boric acid, in the explosion mixture but had an unfavourable action on the phosphorescence. This was also true of alkali borates with the exception of ammonium borate, which gave equally as good results as boric acid. It is suggested that the ammonium borate is decomposed at the high temperature of the explosion and provides the boric acid anhydride, which is the sole effective substance. The favourable action of the latter occurs for admixtures of from 5 to 20 % and it is concluded that the structure of the crystalline medium is affected. W. S. S.

3712. Poisons and Phosphorogens for Phosphorescent Zinc Sulphide. R. Coustal. *Comptes Rendus*, 190. *pp.* 1403–1405, *June* 16, 1930.

The author's work shows that the poisoning or phosphorogen action of a substance added to zinc sulphide depends markedly (*a*) on the conditions of preparation of the zinc sulphide and (*b*) on the type of exciting light employed (electric filament lamp, daylight, mercury arc, etc.). Using a very pure form of zinc sulphide formed by a standardised explosion method, the effect of a large number of substances on the phosphorescence was examined. Most substances have some slight action, but the group of metals of atomic numbers 25, 26, 27, 28, 29 (Zinc = 30) appear as hyperactive poisons or phosphorogens. Mn is a phosphorogen; Fe, Ni and Co are poisons. The effect of Cu is sometimes that of a poison and sometimes that of a phosphorogen depending on its concentration and the character of the exciting light. W. S. S.

3713. Mechanics of Photons. V. Fock. *Comptes Rendus*, 190. *pp.* 1399–1401, *June* 16, 1930.

A so-called " bivector " is formed by considering together two vectors. The bivector $F \equiv \{E, H\}$, where E and H are the electric and magnetic forces, is defined and the matrix operator $H \equiv \frac{hc}{2\pi i}\begin{Bmatrix} 0 & -\mathrm{curl} \\ \mathrm{curl} & 0 \end{Bmatrix}$. Maxwell's equations in full space are then summed up in one result of the form $HF + \frac{h}{2\pi i}\frac{\partial F}{\partial t} = 0$. It is shown that the operator H is autoconjugate (*selbstadjungiert*), and the operational equation is taken as the wave equation of the photon. Putting $HF = \lambda F$ inside a volume enclosed by reflecting walls, the eigenvalues λ_n give the energy quanta $\lambda_n = h\nu_n$ where the ν_n are the frequencies of oscillation proper to the volume considered. The analogy with the wave equation of the electron is extended by computing the operator appropriate to the velocity of the photon. In the mechanics of the photon there are, however, no operators corresponding to the momentum operators of the electron $p_x = \frac{h}{2\pi i}\frac{\partial}{\partial x}$, etc.

It is considered that the present method should lead to a derivation of Einstein's law of energy fluctuations in an enclosure, and should prove useful in attacking the problem of the interaction between matter and radiation. W. S. S.

3714. Relation of Electronic Waves to Light Quanta and to Planck's Law. J. J. Thomson. *Phil. Mag.* 9. *pp.* 1185–1194, *June*, 1930.

The electron is regarded as consisting of two parts, the core carrying a charge of negative electricity *e*, and a system of waves surrounding the core, the velocity of the core being the group velocity of the waves in its neighbourhood. The wave system and the core may both have energy and momentum, and if the core is suddenly stopped the waves may go on and travel away from the charge. It is suggested that light quanta consist of a special type of such wave systems, so that the structure of light quanta is very closely connected with that of electrons. Special attention is paid to the system of waves forming part of an electron, the core of which travels in a closed orbit round the nucleus of an atom. The wave fronts intersect the paths of the core at right angles, the energy also travels in closed circuits, none is lost. Under certain conditions this system of electronic waves, moving round a closed circuit, or a portion of it, may escape from the core and form a quantum of light travelling with the velocity of light, and having a definite frequency. With a free electron, like a kathode ray, the X-rays produced by impact on a target must owe any definite frequency they possess to the influence of the target. Considers also the continuous spectrum given out by a hot body in terms of the theory. H. N. A.

3715. Twilight Coloration of Clouds. P. Barreca. *N. Cimento*, 7. *pp.* 225–244, *June*, 1930.

Previous conclusions [see Abstract 588 (1928)] confirmed that there exists a system of annular spectra round the earth which colour the clouds as they pass with the rotation of the earth. The regularity is so great that it is possible to reduce the observations to the case of the Equator and the Equinox, which are found to be comparable. Certain magnitudes in these spectra are measured in kilometres. A. D.

3716. Spectroscopy of the Light from the Night Sky. J. C. McLennan and H. J. C. Ireton. *Canad. J. of Research*, 2. *pp.* 279–290, *April*, 1930.

This paper describes the development and the construction, with optical details, of a spectrograph of high light power suitable for the photography of the spectrum of the light of the moonless night sky and the spectra of auroral displays. Preliminary experiments carried out with it in England and in Canada are described. Typical spectrograms recorded by the instrument are shown. Suggestions for still further increasing the efficiency of the spectrograph are made. The advantages of using the spectrograph described are pointed out. Additional investigations of auroral phenomena, and an extension of those previously made, are outlined. AUTHORS.

3717. Total Energy Value of Sunlight and Moonlight. A. B. Klugh and W. R. Sawyer. *Canad. J. of Research*, 2. *pp.* 396–402, *June*, 1930.

On account of investigations on the effect of light on various marine and fresh-water organisms which are being carried on at the Atlantic Biological Station, St. Andrews, N.B., Canada, it was necessary to know something of the energy values of sunlight, especially of its ultra-violet component, and also of moonlight. Consequently a Moll-Richard-Gorczýnski pyrheliometer, and various other apparatus for measuring natural radiation, were brought into use in the summer of 1926. It was found that the sun, shining from a clear sky in June at this station (Lat. 45° N. sea-level) had an energy value of 1·55 gm. cal. per sq. cm. per min., and data on the effects of clouds and haze were obtained. The ultra-violet component of the sun's radiation was found to be 2 % of the total radiation in August. The energy value of the light of the full moon, at an elevation of 22° above the horizon in July, was found to be 0·0000029 gm. cal. per sq. cm. per min., or about 1/555,000 that of full noon June sunlight.

AUTHORS.

3718. Absorption Spectra of OsO_4 in Gaseous State and in Solution. S. Kato. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 249. *pp.* 248–253, *June* 20, 1930. *In English.*

The absorption lines from wave-length 2319 to 3201 have been measured for gaseous osmium oxide, and for the corresponding acid in aqueous solution of strength 1/1000 molar. The lines fall into two groups, of which the one with the longer wave-length suffers a frequency displacement of about 149 $cm.^{-1}$, and the other a displacement of about 246 $cm.^{-1}$ in solution.

J. H. A.

3719. Absorption Band Spectrum of Chlorine. Part II. A. Elliott. *Roy. Soc., Proc.* 127. *pp.* 638–657, *June* 2, 1930.

New bands are observed in the spectrum of chlorine, got by the passage of light from a carbon arc through a light-path of length 9 m. in chlorine. Only P and R branches are found. Term differences are tabulated for the upper and lower states for $Cl_{35}Cl_{35}$ and $Cl_{35}Cl_{37}$ molecules. The heat of dissociation of normal chlorine molecules works out at 56·9 cal., in agreement with the chemical value 57·00 cal. The origin frequencies can be fitted to $\nu = 17657\cdot7 - (255\cdot7\,v' - 5\cdot42\,v'^2) - (560\cdot90'' - 4\cdot0\,v''^2)$. The $Cl_{35}Cl_{35}$ bands show alternating intensities; the ratio of intensity of strong to weak lines is measured as 1·36 : 1, and reasons are given for estimating the true value as 1·4 : 1. This agrees with a nuclear spin of 5/2. In conclusion, tables are given of vibrational and rotational constants for the molecules $Cl_{35}Cl_{35}$ and $Cl_{35}Cl_{37}$. [See also Abstract 2750 (1929).]

A. C. M.

3720. Some Bands of the Carbon Molecule. G. H. Dieke and W. Lochte-Holtgreven. *Zeits. f. Physik*, 62. 11–12. *pp.* 767–794, 1930.

A band system of the C_2 molecule not previously investigated accurately is photographed under high dispersion and analysed. It is found that the origin of the bands is a $'\pi \rightarrow '\pi$ transition. This is the first example of normal $'\pi \rightarrow '\pi$ bands to be discovered. The structure agrees in all details with that expected from theory. It is found that the end state of the bands is normal, while the initial state of the molecule has a tendency to become unstable. One rotation term of the end state is disturbed. In many respects the bands show great similarity to the Swan bands, so that it is probable that the new bands are the singlet bands corresponding to the Swan bands.

C. B. A.

3721. Application of Kar's Theory of the Intermittent Effect to Band Spectra in the Infra-Red. B. N. Biswas. *Zeits. f. Physik*, 62. 11–12. *pp.* 852–854, 1930.

In an earlier work [see Abstract 2166 (1930)], Kar and the author have used this theory to find the expression for the energy of an anharmonic oscillator, which is to be referred to the asymmetric term x^2 in the differential equation for its motion. The theory is now applied further to examine the influence of the symmetrical term x^3. Using the method of successive approximation and by subsequent integration an expression is obtained for the displacement (X), and the resultant elongation of the symmetrical oscillator is consequently $x_T + X_T$, where x_T is the elongation due to the simple harmonic motion. The potential energy of the system is therefore $V = \frac{1}{2}n^2m(x_T + X_T)^2$. Neglecting the square of the small quantity X_T, the mean potential energy, the kinetic energy and the total energy are found. T. B.

3722. Intensities of Vibration-Rotation Bands with Special Reference to HCl. J. L. Dunham. *Phys. Rev.* 35. *pp.* 1347–1354, *June*, 1930.

Assuming Morse's expression [see Abstract 63 (1930)] and also the simple series expansion, the intensity ratios for different lines are calculated. The results are compared with the observations of the author and Bourgin, with rather inconclusive results. J. H. A.

3723. Infra-Red Absorption of Some Organic Liquids under High Resolution. R. B. Barnes. *Phys. Rev.* 35. *pp.* 1524–1532. *June* 15, 1930.

Raman shifts are believed to be correlated with the absorption lines of a substance, but the former are usually known far more accurately than the latter. In this work the spectrum from 3·1 μ to 3·6 μ has been measured to an accuracy of 0·003 μ for benzene and eight other cyclic compounds. The bands due to the C — H vibration may be followed in all cases. J. H. A.

3724. Infra-Red Absorption Spectrum of Sodium Nitrate. C. Schaefer and C. Bormuth. *Zeits. f. Physik*, 62. 7–8. *pp.* 508–509, 1930.

The infra-red absorption spectrum of sodium nitrate has been measured and it is shown that it can be built up from a set of three active ground terms and one inactive term. The same combination of terms built up from closely similar ground terms has been shown in earlier work [see Abstract 1033 (1927)] to fit the absorption spectrum of the carbonates. F. J. W.

3725. Photoelectric Measurements of Intensity in the Mercury Spectrum. L. S. Ornstein and J. F. Custers. *K. Akad. Amsterdam, Proc.* 33. 5. *pp.* 473–487, 1930.

The investigation is a continuation of that of Ornstein, Burger and Kapuscinski, who, using similar conditions of excitation, have studied the behaviour of helium [see Abstract 157 (1929)]. The authors have made measurements on the lines of the triplet $2^3P_{012}-2^3S_1$ (wave-lengths 5461, 4358 and 4047 Å.) and the line $2^1P_1-3^1S_0$ (wave-length 4916 Å.); it will also be possible with the apparatus employed to measure the first singlet line $2^1P_1-2^1S_0$. Alteration of the pressure of the vapour may be expected to affect the intensity of the lines, since it may alter the self-absorption. A change in the mean free path of the electrons will cause a change in the degree of excitation of definite levels, and so alter the intensity relations. The apparatus used, which includes an amplifier for the current from the photoelectric cell, is described, and numerous curves are given showing the relations between the intensities of the lines in question with different currents in the discharge tube, different pressures and different voltages. These are in part of a complicated nature, but evidence is obtained of self-absorption at high pressures, of the effect of the mean free path of the electrons, and that of the excitation functions of the initial states concerned. H. N. A.

3726. Separation of Arc and Spark Lines of Oxygen and Nitrogen in the Far Ultra-Violet. K. Wien. *Ann. d. Physik*, 5. 5. *pp.* 553–561, *June* 28, 1930.

The method of W. Wien is used whereby positive rays enter suddenly a low-pressure space where there is a transverse electric field, so that charged particles are deviated while uncharged ones are not. In this way the arc and spark lines may be distinguished, and it is found that in nitrogen the following are arc lines: 1492, 1243, 1200, 1168, 1134, 963 and 951 Å.; while the following are spark lines: 1085 and 915 Å. In oxygen the lines 1305 and 990 Å. were arc lines, while the line 834 Å. was too weak for its origin to be certain. The carbon line 1334 Å. is a spark line. A. C. M.

3727. Properties of the Abnormal Series and Rays in Atomic Spectra. H. Deslandres. *Comptes Rendus*, 190. *pp.* 1250–1254, *June* 2, 1930.

Those rays or series which show a much greater difference when the O–C steps are examined than is indicated by the calculated differences obtained from the Rydberg, Hicks or Ritz formulæ are termed abnormal rays. Such rays and series for helium, lithium and sodium are briefly examined, considering the fact that the *raies ultimes* and other rays of a series are multiples of an elementary frequency $d_1 = 1062 \cdot 5$. **Errata,** *ibid.*, p. 1579, June 30, 1930. R. C. F.

3728. Continuous Hydrogen Spectrum. W. Finkelnburg. *Zeits. f. Physik*, 62. 9–10. *pp.* 624–635, 1930.

Calculates the velocity of the atoms according to the hypothesis of Winans and Stueckelberg, which regards the energy of excitation of the H_2 molecule as divided into dissociation energy, radiation energy (continuous spectrum) and kinetic energy of the atoms. Finds values of the order of 10^6 cm./sec., which should be measurable by Doppler breadth measurements. Measurements of the excitation voltage (12·6 volts) by the excitation dispersion method appear to make it certain that the continuous spectrum is in no way to be ascribed to H_2^+. Unless there exists some unknown H_2 term it seems necessary to assume a critical third state of nuclear vibration; the relation between the continuous spectrum and the pressure can then be explained. Though the distribution of intensity seems to agree with the rough calculation of Winans and Stueckelberg satisfactorily a new calculation seems necessary in view of the author's results. The excitation dispersion photographs go to show that the spectrum has a remarkably narrowly limited excitation function; this and other related phenomena can be explained by means of the theory.
H. N. A.

3729. Relation between the Intensities of Balmer and Paschen Lines. L. S. Ornstein and H. C. Burger. *Zeits. f. Physik*, 62. 9–10. *pp.* 636–639, 1930.

It was found that the ratio H_β/P_α for pressures from 0·001 to 0·1, and with currents of 100 to 300 mA, was constant and equal to 2·6; H_γ/P_β could in some cases be determined approximately as 2·5 and H_δ/P_γ as 2. These numbers are considerably smaller than would be expected if only P states were excited, the calculated ratios in this case are 11·0, 8·2 and 7·7. The assumption of a distribution of the partial states of the four-quantum state according to the statistical weights, which gives the respective ratios 3·6, 3·4 and 3·4, does not agree with the observations. The author thinks it probable that the reason for the actual low values is that the excitation functions of the four-quantum S, P, D and F states stand in the following order of magnitude S, D, F, P. There is an analogous case in the singlet spectrum of helium, where the order is S, D, P, while in the triplet spectrum it is S, P, D. It is suggested that the excitation function of hydrogen should be calculated for small velocities by means of quantum mechanics. H. N. A.

3730. Spark Spectrum of Neon in the Negative Glow. M. J. Druyvesteyn. *Zeits. f. Physik*, 62. 11–12. *pp.* 764–766, 1930.

Determines the value of the kathode fall at which the spark lines of the neon glow light disappear. They appear as soon as the kathode fall is greater than the excitation potential of the lines and are produced by electrons traversing the kathode fall without loss of energy, thus confirming the writer's previous conclusion. [See Abstract 636 (1930).]

E. E. F. d'A.

3731. Zeeman Effect of Neon. K. Murakawa and T. Iwama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, 13. *pp.* 283–291, *June* 28, 1930. *In English.*

A quartz-glass discharge tube, provided with tungsten electrodes and excited by a 2 kV transformer, was used. Photographs as far as 8377 Å. were made with a 32-plate echelon grating, tables of results and reproductions of photographs being given. It is believed that results in regions above 6717 Å. and below 5853 Å. have not previously been given. F. S.

3732. Elementary Theory of the Zeeman Effect. J. Zahradníček. *Zeits. f. Physik*, 62. 9–10. *pp.* 694–695, 1930.

Transforms the equations of motions of an electron in a homogeneous magnetic field by means of the substitution $x + iy = Z$, where i is the imaginary unit; and thus obtains the alteration in the frequency of the emitted light. $\Delta\omega = \pm He/2cm$, or in wave-lengths $\Delta\lambda = \pm He\lambda^2/4\pi C^2 m$.

H. N. A.

3733. Zeeman Effect in OH Bands. G. M. Almy. *Phys. Rev.* 35. *pp.* 1495–1512, *June* 15, 1930.

The OH bands in the spectrum of water vapour, in the near ultra-violet, have been examined in fields up to 34,000 gauss, using a 21-foot grating. The results are in good agreement with Hill's theory [see Abstract 1878 (1930)]. J. H. A.

3734. Zeeman Effect in Red CaH Bands. W. W. Watson and W. Bender. *Phys. Rev.* 35. *pp.* 1513–1523, *June* 15, 1930.

The bands have been examined in fields up to 30,000 gauss, and the data are compared with Hill's theory [see Abstract 1878 (1930)]. J. H. A.

3735. Theory of Stark Effect in Strong Fields. C. Lanczos. *Zeits. f. Physik*, 62. 7–8. *pp.* 518–544, 1930.

Treats the wave-mechanics equation of the Stark effect by means of a direct asymptotical solution, instead of using the usual perturbation method, which is shown to be unsuitable in this problem. The result is that there exists a widely extending external charge cloud on the positive side of the field, which, starting from the interior of the atom, extends to the positive plate of the condenser, and which with strong fields may include a definite quantity of charge, so that, owing to the diminution resulting in the interior of the atom, a reduction in the intensity of the spectral lines results. The lines also have theoretically a finite width, since it appears that the discrete term system ceases to exist as such, and passes into a continuous spectrum. The charge cloud on the side of the atom towards the negative plate is not much deformed, but is pressed in towards the nucleus. H. N. A.

3736. Character of Shifts in Different Series of Iron Lines by Disruptive Discharge. H. Nagaoka, T. Futagami and I. Machida. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 224–227, *June*, 1930. *In English.*

A continuation of the work described in a previous paper [see Abstract 3135 (1930)]. The iron spectrum produced by the disruptive discharge has now been examined. The conditions in the spark gap are such that the lines undergo Stark and Zeeman effects, and also a shift due to pressure. The lines examined can be separated into seven types, according as their shifts are towards the red or the blue or both (usually unsymmetrical), or as they show reversal, or no effect at all. No attempt has yet been made to analyse the observed effect into any of its possible components. C. B. A.

3737. Raman Effect and Chemical Constitution. Lespieau and Bourguel. *Comptes Rendus*, 190. *pp.* 1504–1506, *June* 23, 1930.

Light scattering is investigated in compounds containing carbon atoms joined by double bonds. Ethylene has two strong lines, 1340 and 1620. In the present paper it is shown that the presence of such a double bond gives rise to a line near to 1620 in the Raman effect, and that the actual value depends upon the neighbouring substituted radicals and the position of the double bond in the structure as a whole. In particular, the value depends upon whether the double bond is in a benzene ring or in a side-chain. The reasoning is applied to the consideration of the structure of phenyltrimethylene, which was investigated together with its isomers, allyl- and propenylbenzene. The first was the only one to give just one ethylene line, that of the benzene ring, and thus to have no double bond in the side-chain. Also in phenyltrimethylene there was no sign of the lines 2870, 2920, 2960 which characterise the C-H band in the CH_2, CH_3 radicles of open chains, although they appeared in the isomers. A. C. M.

3738. Doppler Effect in Relation to Atoms. D. S. Kothari. *Indian Journ. Phys.* 4. *pp.* 575–584, *June* 30, 1930.

It is shown that if a sphere contracts continuously and has perfectly reflecting non-conducting walls there is a similarity between the effects produced when the enclosure is filled with radiation and with matter. The Doppler effect in matter is exactly similar to that in radiation if the results are interpreted in terms of the hypothesis of matter waves introduced by de Broglie. The Compton effect in radiation can be dealt with similarly in the collision of α-particles with atomic nuclei, while the Raman effect is similar to the results of the resonance potential experiments of Franck and Hertz. [See also Abstract 157 (1930).] R. S. R.

3739. New Phenomena in X-Ray Scattering. J. A. Gray and W. H. Zinn. *Canad. J. of Research,* 37. *pp.* 291–293, *April,* 1930.

X-rays were scattered by a number of samples of graphite and charcoal in such a way that the scattering increased in intensity as the scattering angle approached zero. In certain cases the scattering at small angles was very similar to the scattering of α-particles; this result cannot be explained easily on the basis of the current views on the nature of X-rays and matter. Experiments are being devised to test what part adsorbed gases play in the phenomena, and to determine whether the scattering at very small angles is a true particle scattering. AUTHORS.

3740. Scattering of X-Rays in Water and in Aqueous Solutions. W. Good. *Helv. Phys. Acta,* 3. 3–4. *pp.* 205–248, 1930. *In German.*

The work up to the present on the rings obtained by the scattering of X-rays by water is reviewed. Photometric measurements are carried out on the rings scattered by water and by aqueous solutions of lithium chloride, calcium chloride, ammonium sulphate, potassium carbonate, potassium chloride, potassium bromide, potassium iodide and barium chloride. Two maxima are observed with water. This is explained by the supposition of temporary associations of molecules of water together so as to form rudimentary ice-crystals, which therefore have a grating-constant. The water thus consists at any moment of ice-crystals, together with randomly orientated water molecules. It is found that a fit can be made to the scattering curves obtained if about 15 % of the molecules are in temporary crystals. In the Li-Cl solution only the maximum appears, due to the prevention of formation of ice-crystals by the hydration of the lithium ions. The $CaCl_2$ solution showed a trace of separation into two peaks. With $(NH_4)_2SO_4$ solution a new inner peak appears, possibly due to association of water molecules and NH_4^+ ions. **Errata,** *ibid.* 3. 5–6. p. 346, 1930. A. C. M.

3741. Interference Measurements with Single Molecules. P. Debye. *Phys. Soc., Proc.* 42. *pp.* 340–351, *June* 15, 1930.

In the diffraction of X-rays by crystals every atom is supposed to be the centre of a secondary radiation, and the observed effects are accounted for by the phase-differences of the secondary rays set up by the spatial arrangement of the atoms in regular lattices. But any atomic structure will give rise to interference; and even a very small number of atoms will still give an observable effect, provided the wave-length of the radiation is comparable with the atomic distances. We have to expect that even for a single molecule, containing perhaps only a few atoms, the angular intensity-distribution of, say, scattered X-radiation will show the effect of the path-differences arising from the peculiar spatial distances between the atoms in the molecule. The observation of such an effect must therefore lead to the absolute measurement of atomic distances in free molecules. Working on these lines, not without difficulties which are discussed, the author has found it possible, using CCl_4 vapour, to observe the first three interference-maxima and to ascertain that the distance between the Cl atoms in CCl_4 is 3·1 Å. The distance between the Cl atoms increases if a Cl atom is replaced by an H atom. In the two isomeric dichlormethylenes, cis- and trans-, the distances between the Cl atoms are respectively 3·6 and 4·1 Å. The size of the molecule plays an important part in the results, which are illustrated by curves. Analogous experiments have been made with electron discharges. A. D.

3742. X-Ray Investigations of Liquid Crystals. Part I. Para-Azoxyanisole. P. W. Glamann, K. Herrmann and A. H. Krummacher. *Zeits. f. Krist.* 74. *pp.* 73–94, *June*, 1930.

Previous researches [see Abstracts 948 and 1307 (1928)] are first discussed. Then follows an account of X-ray experiments with *p*-azoxyanisole in both the crystalline and amorphous phase, with and without the application of a magnetic field. From measurements of the rings obtained it is found that the deflection angle of interference is not changed by the magnetic field and that the diameters of the rings are dependent on temperature. The thickness of the molecule is determined by means of the Bragg interference equation. By means of short-wave radiation (MoK$_\alpha$), a third ring has been found, which is split in the direction of the magnetic field, although whether of intermolecular or intramolecular origin cannot yet be decided. H. H. Ho.

3743. K-Ionising Power of Fast Electrons. F. Wisshak. *Ann. d. Physik*, 5. 4. *pp.* 507–552, *June* 18, 1930.

The number of atoms ionised in the K level by a fast electron along the whole of its path during its passage through matter is measured for Cr, Cu, Mo and Ag. It is calculated as a function of the energy of the electron and of the atomic number of the atoms, and the absolute value can be deduced from the intensities of the K$_\alpha$ lines excited in the ionisation. The energy of the electrons is measured calorimetrically from the heating of the antikathode, and the K-line intensities with a Bragg spectrometer by the ionisation method. Error due to absorption of the radiation inside the antikathode is eliminated experimentally. The intensity of the continuous radiation is measured and deducted from the observed total radiation at the position of the K$_\alpha$ line, and correction is also made for fluorescence indirectly excited by it. The absolute intensity of the directly excited characteristic radiation is then determined by comparison with the known intensity of the continuous radiation. The results thence obtained are compared with the theoretical values of J. J. Thomson, and with an empirical formula due to D. L. Webster. C. B. A.

3744. Absorption of Long Wave-Length X-Rays (2-10 Å.) in Light Elements. B. Woernle. *Ann. d. Physik*, 5. 4. *pp.* 475–506, *June* 18, 1930.

Absorption measurements have been made in the long X-ray region using a vacuum ionisation spectrometer. In order to obtain accurate results a null method of measurement was employed. Thus the ionisation chamber consists of a long brass tube containing two sets of measuring electrodes, the first pair of plates being shorter (approximately half the length in several experiments) than the second pair. The beam of X-rays traverses the tube along its axis, passing first between the short electrodes and then between the longer ones. By suitable adjustment of the gas pressure in the ionisation chamber it is possible to arrange that the energies absorbed from the beam in passing between the two sets of plates are equal. If the signs of the charge on the active electrodes are opposite in the two cases, an electrometer connected to both the measuring electrodes remains at rest. From the gas pressure required, it is possible to deduce the absorption cofficients of the gas for the X-ray beam. The absorption coefficient of air, nitrogen, oxygen, neon, argon, sulphur dioxide, and the vapours of pentane and carbon tetrachloride from $\lambda = 2\cdot3$ to $\lambda = 9\cdot9$ Å. were determined. It is shown that the law due to Jönsson that the electron absorption coefficient is a function merely of the product N λ, is not accurate for light elements and that systematic deviations show themselves. For sulphur, chlorine and argon the K-absorption "jump" was determined. In agreement with Jōnsson, the value of the discontinuity was found to be in very close approximation to the ratio of the energies of the K and L_1 levels of the elements. W. V. M.

3745. Spectroscopy of "Ultra-Soft" X-Rays. M. Siegbahn and T. Magnusson. *Zeits. f. Physik*, 62. 7–8. *pp*. 435–456, 1930.

The paper discusses the spectroscopic methods available for the investigation of the "ultra-soft" X-rays in the region from 10 to 100 Å. An oblique-incidence method is tried out in which the plane grating itself acts as the second slit. For this purpose gratings are prepared with a ruling machine constructed on a new principle. A description of the machine, and of the vacuum spectrograph built for testing the gratings, is given. These gratings still give well-defined spectra when the number of lines per mm. is as high as 1800. For comparison, microphotographs of the new gratings and of those from other ruling machines are given. [See following Abstract.] C. B. A.

3746. Focal Properties of Optical Diffraction Gratings and Influence of Grating Error on Accuracy of Measurement in the "Ultra-Soft" X-Ray Region Using Plane Gratings. S. Fagerberg. *Zeits. f. Physik*, 62. 7–8. *pp*. 457–472, 1930.

The new type of grating described by Siegbahn and Magnusson possesses serious focal properties. In this paper such properties are discussed, and a simple method is given for determining the variation of grating constant corresponding to them. From this the influence of various types of grating error on the absolute accuracy of measurements in the "ultra-soft" X-ray region made with plane gratings is investigated. In particular, the periodic errors of ordinary gratings are amplified. The diffraction pattern for two types of error is calculated, and a general expression is given for the displacement of the central maximum in one of these cases. The elimination of grating errors is discussed and the advantages of the Siegbahn type are described. [See preceding Abstract.] C. B. A.

3747. Activation of Matter by an Electrified Point. G. Reboul and G. Déchène. *Comptes Rendus*, 190. *pp*. 1294–1296, *June* 2, 1930.

The origin of the active deposits formed by an electrified point or by resistance cells as described previously [see Abstract 2566 (1930)] is investigated, and the deposit shown to consist of radium A + B + C and thorium A, presumably arising from disintegration of the emanations from radium and thorium. The amount of such deposit varies greatly (up to 1000 %) in different rooms of the same building, and is much diminished in a closed vessel. C. A. S.

RADIOACTIVITY.

3748. Average Life of Ionium. (Mme.) P. Curie and (Mme.) S. Cotelle. *Comptes Rendus*, 190. *pp.* 1289–1292, *June* 2, 1930.

Assuming 230 as the atomic weight of ionium, the amount of ionium in a sample of mixed oxides of ionium and thorium was determined to be 0·02515 gm. By estimating, over a total period of 768 days, the amount of radon evolved therefrom the rate of destruction of the ionium in the sample was calculated to be $2 \cdot 118 \times 10^{-7}$ gm. per annum. From this the average life of ionium is deduced as $8 \cdot 23 \times 10^4$ years. The probable error is 3 % in the atomic weight of ionium and 3 % in the estimation of radon. C. A. S.

3749. Radioactivity of Materials from Old Roofing. A. Boutaric and Madeleine Roy. *Comptes Rendus*, 190. *pp.* 1410–1412, *June* 16, 1930.

A piece of slate, a glass tile and samples of lead from positions in which the amounts of exposure to rain varied considerably all show radioactivity, in amount qualitatively varying with the amount of such exposure. That such radioactivity is due to matter brought by rain and is entirely independent of solar activity is finally proved by the radioactivity of sand and charcoal used to filter rain-water for 30 years, during which period both had been in complete darkness. [See Abstracts 2571, 2572 and 2850 (1930).] C. A. S.

3750. Relation between Different Reactions for Depositing Polonium. Existence of Insoluble Derivatives Forming Centrifugable Colloidal Precipitates. M. Guillot. *Comptes Rendus*, 190. *pp.* 1553–1555, *June* 30, 1930.

Gives further details as to the behaviour of polonium solutions when treated with various reagents and centrifuged without hydrolysis. The results are to be discussed later. H. N. A.

3751. Arc Spectrum of Radium Emanation. E. Rasmussen. *Zeits. f. Physik*, 62. 7–8. *pp.* 494–507, 1930.

The spectrum of radium emanation has been photographed and measured. By the addition of helium, argon and neon to the discharge tube it has been possible to distinguish between the arc and spark spectra; for with the addition of argon only the arc spectrum appears, while with neon and helium the spark spectrum appears. In the arc spectrum 115 lines have been photographed and 110 of them classified. The resonance lines have also been photographed. The ionisation potential has been calculated to be 10·689 volts. F. J. W.

3752. Effective Sectional Areas of Free Atomic Nuclei. W. Wessel. *Ann. d. Physik*, 5. 5. *pp.* 611–624, *June* 28, 1930.

The probability of the formation of ions, or of atoms, when electrons meet atomic nuclei, characterised by an effective sectional area, is calculated for the general case, and worked out explicitly for the passage into the ground state, certain excited states, and, in the sense of Bohr's theory, into very eccentric orbits. The general formulæ make it possible to determine the effective sectional area exactly for very high velocities (greater than about 50 volts); the explicit ones suffice for the discussion of the behaviour of the different types of orbit for small velocities, down to about 2 volts, and to fix the value to within from 10 to 20 %. One of the chief objects of the investigation was to make it clear whether it is possible in this way to obtain any explanation of the effect recently observed by Davis and Barnes [see Abstract 229 (1930)], who have found that in the case of He^{++} the probability of recombination has very marked maxima for definite velocities. The author finds that no such maxima are to be expected according to the quantum theory in its present form, so that if the observations of Davis and Barnes are confirmed, very considerable modifications of the theory will be necessary. H. N. A.

3753. New Method of Analysing α-Ray Photographs. L. F. Curtiss. *Bureau of Standards, J. of Research*, 4. *pp.* 663–665, *May*, 1930.

A design for a double camera for photographing α-ray tracks is described. The two cameras permit mutually perpendicular views of the tracks to be taken while at the same time the two object planes coincide throughout. This makes it possible to photograph more tracks at a single exposure than would be possible if the object planes were, as usual, inclined at 90° to each other. The two cameras are rigidly connected so that a new method of analysing the negatives may be used. This method consists in projecting the negatives back on the object plane and orienting a photographic plate so that a single full-size reproduction of the original track is obtained in the plane in which it originally occurred. AUTHOR.

3754. Anomalous Scattering of α-Particles by Transmission through Light Elements. C. Moller. *Zeits. f. Physik*, 62. 1–2. *pp.* 54–70, 1930.

The simple model of the nucleus of Gamow, Condon and Gurney with the help of quantum mechanics permits of the attainment of a qualitative understanding of the anomalous scattering of α-particles by Al and Mg. The dispersion intensity with this model, in conjunction with Born's collision method, is calculated to a first approximation as function of the angle of scattering Θ and the velocity v of the α-particle. Taking one of the magnitudes Θ and v as parameter and the other as variable, there is obtained for each value of the parameter a dispersion curve which with suitable choice of the constants of the model gives the characteristic features of the experimental scattering curve. The radius of the nucleus thus calculated has the order of magnitude to be expected. There is found a displacement principle which regulates the shift of the dispersion curve with variation of the parameter and which has a far-reaching validity for the special model. The displacement principle or law of shift seems on the whole to give correctly the experimental relationship. A general method is given for calculating the more accurate course of the potential in the nucleus from the empirical scattering curve. In this way only the potential in the outer layers of the nucleus can be determined. J. J. S.

3755. Anomalous Scattering of α-Particles from the Quantum Mechanical Point of View. H. S. W. Massey. *Roy. Soc., Proc.* 127. *pp.* 671–677, *June* 2, 1930.

Considers the calculations of Bieler and of Hardmeier from the standpoint of the new mechanics, taking into account the possible effect of Planck's constant h, which has not previously been considered. Shows that it is almost certain owing to dimensional considerations that h must appear in formulæ representing scattering by higher power laws, and even when $n = 2$. It follows that the theories of Bieler and Hardmeier and of Debye have little significance, since the classical formulæ, which do not contain h, break down for higher power laws. The author tests the formulæ obtained by him on the experimental results of Bieler, and of Rutherford and Chadwick, with magnesium and aluminium, and finds that in the first of these metals the scattering results are due to a spherically symmetrical field of force, which at first follows an inverse fifth-power attractive law. At a certain point there is a sudden rise of scattering, and a higher power repulsive force may here come into play. This is of interest in view of the general explanation given of their results by Rutherford and Chadwick. Al appears to show no regularities of the Mg type, but further experimental work seems to be required on these and on other elements. H. N. A.

3756. Radiations Associated with Emission of α-Rays from Polonium. F. Joliot and Irène Curie. *Comptes Rendus,* 190. *pp.* 1292–1294, *June* 2, 1930.

Previous experiments [see Abstract 1903 (1930)] have been repeated with the more intense sources of polonium prepared by volatilisation and deposition on nickel, copper or zirconium; the radiation was absorbed in aluminium or cellophane. Polonium on nickel or copper gives radiation very absorbable in aluminium ($\mu/\rho = 1000$). That this is due to polonium is confirmed by the fact that the same radiation is given by polonium on zirconium, in which case it is accompanied by radiation of $(\mu/\rho)_{Al} = 17$ (L of polonium), and also by radiation of much more penetrating character but too feeble to allow of the determination of its μ/ρ, which is probably M of polonium. Polonium emits a very feeble β-radiation, which is less penetrating than that of radium E. It gives no trace of γ-radiation. Iron is much more absorbent than nickel of the K radiation of copper. C. A. S.

3757. Relation between the Filiation Capacity of Radioactive Atoms and the Velocity of the α-Particles Emitted by Them. G. Fournier. *Comptes Rendus,* 190. *pp.* 1408–1410, *June* 16, 1930.

If the velocity v of α-particles emitted by the various radioactive elements be plotted against the filiation capacity U [see Abstracts 2083 (1927) and 55 (1930)], the curve reduces to a straight line, the relation being $v = 0{\cdot}0818(100 - U)$. Agreement is excellent save for AcC′. It is concluded that the atomic weight of actinium should be 227, and also that the above formula and that of Wolff, $\log R = \xi \log (3/4A - N + K) + \eta$, where R is the range of the α-particle and K, ξ and η constants [see Abstract 339 (1922)], are different expressions of the same fact. C. A. S.

3758. Absorption Method of Investigating β-Particles of High Energy: Maximum Energy of Primary β-Particles of Mesothorium 2. N. Feather. *Phys. Rev.* 35. *pp.* 1559–1567, *June* 15, 1930.

For the primary β-particles of radium C, radium E and mesothorium 2 the maximum effective mass range R has been determined in paper and aluminium by the method of Chalmers. In the two former cases the maximum energy of the particles E is known, and these results and earlier data lead to the relation $R = 0{\cdot}511E - 0{\cdot}091$ for $E > 0{\cdot}7$. R is measured in gm./cm.^{2} and E in millions of electron volts. For mesothorium 2, $R = 0{\cdot}955 \pm 0{\cdot}015$ gm./cm.^{2}, so that the maximum energy of the particles is $2{\cdot}05 \pm 0{\cdot}03 \times 10^6$ electron volts. Reasons are advanced for employing the empirical relation above quoted rather than results obtained with particles of a single velocity, as in the experiments of Varder and Madgwick, in the interpretation of absorption measurements made upon primary β-particles. AUTHOR.

3759. "Barometer Effect" of Cosmic Radiation. C. Dorno. *Gerlands Beitr. z. Geophys.* 26. 4. *pp.* 395–401, 1930.

Previous results [see Abstracts 394 and 2319 (1927), 124 (1928), 2412 (1929), 1905 and 2224 (1930)] and recent observations at Davos and Muottas Muraigl are discussed in their bearing on the "barometer effect." Variations of cosmic radiation, as observed being mainly effected through the Compton effect, are mainly due to non-homogeneity of the atmosphere, presence of dust, moisture, etc. These are usually more pronounced at lower levels; hence "barometer effect" and "height effect," though quite similar in a homogeneous atmosphere, are not so under ordinary conditions. Moreover, changes in radiation travel with the velocity of light, those in atmospheric pressure roughly with that of sound. The greatly increased range of wave-length afforded by cosmic radiation and its much greater penetrating power offer great opportunities for more detailed study of the atmosphere. More and well-distributed observations are urged. C. A. S.

3760. Registered Observations of Cosmic Radiation. F. Lindholm. *Gerlands Beitr. z. Geophys.* 26. 4. *pp.* 416–439, 1930.

New registration series of the cosmic ultra-radiation made on Muottas Muraigl at 2456 m. above sea-level with the Hoffmann apparatus in the winter of 1929 have confirmed the results of the earlier winter series with regard to the periodic fluctuation of the radiation. After reduction of the radiation to constant atmospheric pressure, the new series shows with a lead mantle open above a daily period (minimum at 3 h., 8 h., maximum at 15 h.) with a maximum variation of 2 %. In this winter series also the mean intensity is higher than that in summer. The mean diminution of the intensity per cm. Hg fall in air pressure is 4·9 % in the new series. A daily period in the radiation filtered on all sides by 10 cm. of lead is doubtful, but a yearly variation appears probable as in the weaker radiation. The intensities reduced to constant atmospheric pressure and referred to sidereal time show no characteristic variations with sidereal time recurring at different times of the year. J. J. S.

3761. Recent Cosmic-Ray Experiments. R. A. Millikan and I. S. Bowen. *Nat. Acad. Sci., Proc.* 16. *pp.* 421–425, *June*, 1930.

The results of recent experiments are favourable to the atom-building hypothesis as to the origin of cosmic rays, the main evidence for which is found (1) in the banded structure of the rays; (2) in the energy relations found in Aston's curve and in Einstein's equation, $MC^2 = E$, and checked by observed penetrating powers translated into energies with the aid of the Klein-Nishina formula; and (3) in the practical lack of dependence of the rays upon latitude and direction. The last relation supports the view that the rays are photons rather than electrons. Millikan and Cameron's recent experiments at great altitudes on mountain peaks showed the steeper ionisation depth curve predicted by the Klein-Nishina formula from the hypothetical formation of He out of H. Thus this formula strengthens the atom-building interpretation. The Klein-Nishina formula is only an approximation, for it assumes that absorption is proportional to the number of external electrons, and Chao's recent results [see following Abstract] show that the absorption of the heavy elements for ThC″ rays is greater than that given by the atomic number (or external electron) law, or even by the mass-absorption law. Millikan and Cameron's new results show that this same sort of a breakdown is even more pronounced with cosmic rays, thus suggesting a similarity in nature between γ-rays and cosmic rays. J. J. S.

3762. Absorption Coefficient of Hard γ-Rays. C. Y. Chao. *Nat. Acad. Sci., Proc.* 16. *pp.* 431–433, *June*, 1930.

The absorption coefficient of H_2O, Al, Cu, Zn, Sn and Pb for γ-rays from ThC″ filtered through 6·8 cm. of lead was measured. The γ-rays were in a narrow beam and soft rays were cut off by the lead filter. It was found that the value obtained by dividing the absorption coefficient by the number of electrons per c.c. increases with the atomic number, while according to the theoretical formulæ it should be constant. Alternative explanations are: (1) A part of the scattering may be due to electrons inside the nucleus as suggested by Millikan, who showed that cosmic rays exhibited this same effect in still greater degree. (2) The scattering of a tightly bound electron of the atoms of high atomic numbers may be greater than that of a loosely bound electron. (3) There may still be some true absorption due to the photoelectric effect. J. J. S.

3763. Absorption of Hard Monochromatic γ-Radiation. G. T. P. Tarrant. *Roy. Soc., Proc.* 128. *pp.* 345–359, *July* 1, 1930.

Absorption measurements were made for a large number of elements upon the hard γ-rays from ThC″. The absorber was placed half-way between the source and the ionisation chamber and a lead filter 3·2 cm. thick immediately in front of the chamber, which was protected by lead walls. Thus the absorption dealt with was practically that of homogeneous γ-ratiation of very high frequency, being the hard monochromatic ray having a quantum energy $2 \cdot 649 \times 10^6$ volts. After corrections of 1 % for scattering and about 3 % for the soft component not eliminated by the lead filter, the observed absorption coefficients for certain elements showed that the scattering formula of Klein and Nishina is much more accurate than any others proposed. Although the absorption coefficients of a number of elements agreed with each other and with the Klein-Nishina formula, yet certain others showed an additional absorption which varied irregularly with atomic number and therefore is probably nuclear in origin. [See preceding Abstract.] J. J. S.

3764. Convenient Form of Geiger Tube Counter. L. F. Curtiss. *Bureau of Standards, J. of Research,* 4. *p.* 593, *April*, 1930.

A design of the new Geiger tube counter for detection of γ-radiation or penetrating β-radiation is described which is portable and will maintain its operating characteristics constant over a long period of time. AUTHOR.

HEAT.

3765. Heating of Fluids Flowing through Narrow Tubes. A. Kneschke. *Ann. d. Physik,* 5. 5. *pp.* 670–676, *June* 28, 1930.

A mathematical solution is obtained for the heating of a liquid flowing through a narrow tube round a short length of which a heating coil is wound. The work is based on a complex integral derived in a previous paper [see Abstract 771 (1930)]. A. W.

3766. Theory of Actinometers and Pyranometers. Part II. F. Albrecht and K. Büttner. *Gerlands Beitr. z. Geophys.* 26. 3. *pp.* 241–282, 1930.

In the present paper the class of instruments considered have a difference of temperature between the body receiving the radiation and the envelope. The instruments are classified as mechanical or electrical actinometers. The former have a compensated motion of the zero and include the types of Michelson-Büttner and Brazier, while the latter, possessing thermocouples, include the types of Crova-Sawinoff, Dorno-Thilenius, Linke, Moll-Gorezinsky, the heated strip actinometer, and the heated strip bolometer (Albrecht). The conditions for the optimum construction of the two groups can be found in regard to sensitivity, inertia and temperature coefficient, and these values are calculated for the instruments actually constructed. [See Abstract 3371 (1929).] R. S. R.

3767. Thermal Inertia of the Heated Wire Employed in Measurements [of Flow] with the Hot-Wire Anemometer, and the Determination of Heat Transfer in Unsteady Temperature Conditions. F. Éliás. *Zeits. f. angew. Math. u. Mechanik,* 10. 3. *pp.* 244–247, *June,* 1930.

Heat transfer between a fine, heated wire and a stream of fluid is discussed mathematically. J. S. G. T.

3768. Automatic Thermoregulator. J. A. Beattie and D. D. Jacobus. *J. Phys. Chem.* 34. *pp.* 1254–1259, *June,* 1930.

An automatic thermoregulator is described which has kept the temperature of a stirred liquid bath for long periods of time at any desired value from room-temperature to 450° C. with a variation of ± 0·001° C. The method can also be used to regulate the temperature of air baths.

AUTHORS.

3769. Melting Points and Vapour Pressures of Krypton and Xenon. K. Peters and K. Weil. *Zeits. f. phys. Chem.* 148. *Abt. A.* 1–2. *pp.* 27–35, *June,* 1930.

The melting points of krypton and xenon were determined by two new methods. The melting point of krypton was found to be − 157·0° C. and that of xenon − 112·0° C. The vapour pressure measurements were carried out over a range of temperature and the results were extrapolated up to the boiling points of the two substances. These measurements gave − 151° C. for the boiling point of krypton and − 108·6°C. for that of xenon. The heats of vaporisation were calculated from the measurements, and were found to be 2318·9 per mol. for krypton and 3270·7 per mol. for xenon. F. J. B.

3770. Boiling Point and Chemical Constitution. Part III. Monopolar Organic Compounds with Open Chains. B. Nekrassow. *Zeits. f. phys. Chem.* 148. *Abt. A.* 3. *pp.* 216–226, *June*, 1930.

The formula previously employed [see Abstract 3098 (1929)] is now replaced by the simpler formula $T_s = KM^{\frac{1}{2}}/\Sigma$, where T_s = the absolute temperature of boiling, M = molecular weight, K = characteristic constant, Σ = algebraical sum of the equivalents of the atoms which exist in the molecule and the active structural elements. For normal saturated hydrocarbons from C_4 to C_{10} the formula takes the following form: $T_s = K\sqrt{M/R}$, where R represents the specific refraction. For two normal members of any homologous series we have $T_{s1}\Sigma_1/M_1^{\frac{1}{2}} = K = T_{s2} . \Sigma_2/M_2^{\frac{1}{2}}$. Also $\Sigma_1 = A + \sigma$; $\Sigma_2 = B + \sigma$. σ is the equivalent of the polar group, and A and B represent the sum of the atomic refractions of the carbon and hydrogen atoms of the carbohydrate skeletons of the two members. Hence values of σ and K can be obtained. An example is worked out in the case of the primary alcohols, and seven values of K are found for $C_3H_7CH_2OH$ up to $C_9H_{19}CH_2OH$. A table is given of the equivalents corresponding to active structural elements such as (*a*) double bond $>C=C<$; (*b*) group $=CH_2$; (*c*) $=C=$; (*d*) $>C=C-C=C<$; (*e*) $-C\equiv C-$. These elements (*a*) to (*e*) give respectively equivalents of +1·1, +0·4, −0·8, −0·8, +1·4. The plus sign indicates a higher, the minus sign a lower, boiling point. An example is given of the calculation of Σ for the fairly complicated compound

$$CH_2 = CH . CH_2 . C(CH_3)OH . C_4Hg \text{ normal.}$$

T. B.

3771. Supercooling and Change of State Phenomena for Different Thermometer Liquids. W. Grundmann. *Zeits. f. Instrumentenk.* 50. *pp.* 363–370, *June*, 1930.

Tests were made in the laboratory at low temperatures, and it was found that with Hg as the fluid in a thermometer supercooling of 2° to 3° C. could occur. The viscosity coefficients of some creosotes with and without the addition of alcohol were found, and it was established that creosote mixed with alcohol should not be used below − 20° to − 30° C. as an indicator liquid on account of large internal friction. Below − 30°C. most creosote oils liberate gases, and are thus unreliable as thermometric liquids. It is shown how increased viscosity and gas liberated may be avoided. R. S. R.

3772. Criticism of the Electrical Method for Measuring C_v in Gases. Part IV. Measurements with Argon as Standard. M. Trautz and F. Kaufmann. *Ann. d. Physik*, 5. 5. *pp.* 581–605, *June* 28, 1930.

In earlier measurements [see Abstract 3176 (1930)] air was taken as the standard, but by measurements of air against argon and introducing the most probable assumption of $C_v = 3R/2$ this dependence should be avoided. The apparatus was adjusted so that it could be used for argon. The methods employed consisted of obtaining correcting equations for (1) heat losses by conduction and (2) radiation and ground losses from the time-temperature curve. From these measurements for argon values were obtained for C_v amounting to (1) 4·955 cal. ± 1·5 per thousand for air, and (2) 6·57 cal. for methane at 20° C. R. S. R.

3773. Determination of the Ratio of the Specific Heats (C_p/C_v) of Helium Gas at the Boiling Point of Oxygen by Means of the Velocity of Sound. W. H. Keesom and A. van Itterbeek. *K. Akad. Amsterdam, Proc.* 33. 5. *pp.* 440–446, 1930. *Comm. No.* 209*a from the Phys. Lab., Leiden.*

The authors make use of a closed resonator, with changeable length and constant frequency; this gives the advantage that one is not disturbed by the occurrence of the proper tones of the supply tubes. The value obtained for $(c_p/c_v)_{p=0}$ was 1·661. It was found that the influence of the wall of the resonator upon the velocity of sound could be neglected. H. N. A.

3774. Exact Measurement of the Specific Heats of Solid Substances at High Temperatures. Part III. Specific Heats of Palladium and Tungsten. F. M. Jaeger and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 33. 5. *pp.* 457–472, 1930.

The apparatus and method of measurement previously used [see Abstract 1642 (1928)] have been greatly improved, and an accuracy within a few tenths of 1 % is now claimed. The metals studied being oxidisable are heated in a "perfect vacuum" within an enclosure of iridium-free platinum. The specific heat of palladium between 0° and 1525° C. is given by $c_p = 0{\cdot}053769 + 0{\cdot}0_4271005t - 0{\cdot}0_8793218t^2$. A maximum ($c_p = 0{\cdot}07664$) occurs at 1520° C. Between 1520° and 1549° C. the specific heat is given by

$$c_p = 0{\cdot}053769 + 0{\cdot}0_4271t - 0{\cdot}0_879323t^2 - 0{\cdot}0_{12}7372t^3.$$

The latent heat of fusion at the melting point (about 1560° C.) is estimated at 20 cal. per gm. The specific heat of tungsten has been redetermined, and the results, between 0° and 1604° C., are expressed by the equation $c_p = 0{\cdot}03199 + 0{\cdot}0_54848t - 0{\cdot}0_91174t^2$. The agreement between these results and those of Magnus is excellent, the differences being less than 0·1 %. T. B.

3775. Calorimetric Researches. Part III. Technique for Adiabatic Bomb Calorimetry of High Precision. L. J. P. Keffler. *J. Phys Chem.* 34. *pp.* 1006–1012, *May*, 1930.

For comparison of the heats of combustion of isomeric substances a high degree of precision is essential, since it has been shown that differences may be only 2 or 3 times the experimental error [see Abstract 1454 (1927)]. The main difficulties are discussed, and an apparatus is described by means of which the adiabaticity of a calorimeter can be ensured to within 0·1° C. for the first minute following the ignition, and within 0·01° C. for the remainder of the combustion. A device has also been found which enables the accurate estimation of a temperature interval to within 0·0001° C. H. H. Ho.

3776. Adiabatic Calorimetry. E. Lange and K. P. Miščenko. *Zeits. f. phys. Chem.* 148. *Abt. A.* 3. *pp.* 161–176, *June*, 1930.

A calorimeter is described in which a temperature-rise of the order of 1/10° C. may be used. Temperatures are measured to 1/10,000° C. using a Beckman thermometer divided direct to 1/1000° C. The design for the adiabatic calorimeter with its outer bath is described in detail. As an example of the accuracy attained, the water equivalent of the vessel is shown. With temperature-rises of the orders 0·0065° C., 0·1° C., and 0·44° C. the mean water equivalent was found to be 384·7, 383·1 and 383·7 gm. J. H. A.

3777. Equation of State for Gas Mixtures. Part II. Methods of Combination of Constants of Beattie-Bridgeman Equation of State. J. A. Beattie and S. Ikehara. *Am. Acad., Proc.* 64. *pp.* 127–176, *June*, 1930.

The Beattie-Bridgeman equation of state has been applied to the calculation of the pressures of gaseous mixtures of argon with ethylene, oxygen with ethylene, hydrogen with nitrogen, nitrogen with methane and hydrogen with carbon monoxide. Linear combination for each of the constants gives a satisfactory overall correlation of the compressibility of gas mixtures, and affords a much better representation of the experimental data than either Dalton's law or Amagat's law. It had been experimentally found that certain mixtures of helium and hydrogen have a larger second virial coefficient than the pure gases. The equation of state confirms the existence of such a maximum and predicts a similar phenomenon for other mixtures within certain temperature ranges. The values of the equation of state constants for nitrogen give a satisfactory representation of the compressibility of carbon monoxide to 170 atmos. at 25° C. [See also Abstract 1604 (1929).] H. H. Ho.

3778. Friction, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part VIII. Friction of H_2, He, Ne, A and Their Binary Mixtures. M. Trautz and H. E. Binkele. *Ann. d. Physik*, 5. 5. *pp.* 561–580, *June* 28, 1930.

The general method of experimental procedure and deduction is similar to that followed in a previous paper [see Abstract 2236 (1930)]. The coefficient of friction for H_2, He, Ne and A was measured for each gas at temperatures of 20°, 100°, 200° and 250° C. The temperature function of the friction, in the cases of H_2 and He, varies with the temperature according to the equation $\eta_1/\eta_2 = (T_1/T_2)^n$, where $n = 2/3$, also at high temperatures. From which is deduced that for heavy gases $\eta = \text{const.}(T)^{0\cdot 6} \times 1/(1 + c/T)$. For A the Sutherland equation is valid. In the neighbourhood of T_k, n and C for other gases assume a maximum value. With increase of temperature, n falls to a value less than unity but with a limiting value between 0·6 and 0·5. Over the same range of temperatures as given above, namely, 20°, 100°, 200° and 250° C., the friction isotherms of the mixtures (H_2+He), (H_2+Ne), (H_2+A), (He+Ne), (He+A) and (Ne+A) were determined, and the constants of the mixture equations (q and F) were evaluated. The average value of the relationship signified by q is seen to be within the error quotient of pure material constants, so that the triangular relationship is valid within the six pairs of gases given above. The value of q, within ± 5 %, lies between 0·45 and 1·0 for the six pairs of gases, whilst F lies between 1·0 and 1·5. q is shown to be according to the van der Waals parallel relationship, whilst the constants ϕ, q and $M\theta$, evaluated in the final expression, are shown to correspond to the main quantum numbers. S. G. B.

3779. Relationship between Gas Pressure and the Translatory Energy of the Gas Molecule. W. Anderson. *Zeits. f. Physik*, 62. 9–10. *pp.* 719–720, 1930.

A reply to the previous criticism by K. Schaposchnikow [see Abstract 2238 (1930)] with regard to the dispute as to whether for a light quantum the formula giving the value of p should show it as equal to $1/3E_{trans}$ or to $2/3E_{trans}$. The present note simply shows that the author adheres to his previous view and is prepared to vindicate it by argument. S. G. B.

3780. Arbitrary and Polytropic Changes of State. W. Jazyna (Jacyno). *Zeits. f. Physik*, 62. 11–12. *pp.* 842–845, 1930.

In many applications of thermodynamics the so-called "polytropic" changes of state introduced by Zeuner play an important part. For gases, more strictly for Clapeyron's systems, ($pv = RT$), the known processes satisfy the differential equations: $dp/p + ndv/v = 0$; $dT/T + (n - l)dv/v = 0$; $dT/T - (n - l)dp/p = 0$, where n (the exponent of the polytrope) $= (C_n - C_p)/(C_n - C_v)$, and C_n indicates the polytropic specific heat. If n is regarded as a variable quantity we can only obtain the integrated form of the polytrope on the assumption that $dp/p + ndv/v = -\log v \,.\, dn$. Putting $pv^n = \phi(x)$ where x is an arbitrary parameter, the author shows that the function ϕ must be of the form $\phi(x) = e^{\log v \,.\, dn}$, and hence he determines the final equations of the polytrope, which include the "arbitrary processes." Using S . T-coordinates and the equation $F(ST) = 0$, defining the arbitrary process, he draws the "touching polytrope," a curve which has the same tangent at the point under consideration as the curve of the arbitrary process. He proceeds to find a value for n, the exponent of the touching polytrope, and shows that the generalised specific heat in the arbitrary process is equal to the polytropic specific heat of the touching polytrope. T. B.

3781. Hybrid Character of Molecular Motion. W. Jazyna (Jacyno). *Zeits. f. Physik*, 62. 11–12. *pp.* 846–851, 1930.

It has been previously shown [see Abstract 1112 (1930)] that not all molecular movements are equivalent, and it became necessary to consider a special "heat molecular weight." The author explains that the frictional heat does not arise suddenly from the vortex or convection energy respectively, and that the convection energy only in monatomic gases is completely converted into heat; in gases not monatomic this energy is only partly converted into heat, and the residual amount limits the transformation into other forms of energy. Molecules can either be divided into "quick" and "slow," assuming that the one kind produces the temperature and the other the pressure effect, or perhaps a hybrid nature can be ascribed to the molecular motion, *i.e.*, in general this motion may be partly chaotic and partly regular. The author calculates "regularity" and "distribution" coefficients respectively for different gases, He, A, air, CO, NH_3, CH_4, etc., giving a table of values and a diagram with the regularity coefficient plotted against the number of atoms. The graph obtained is smooth, exclusive of variations shown, for example, by SO_2 and CH_4. T. B.

SOUND.

3782. Depression and Enhancement of Auditory Sensitivity. J. F. Allen. *Phil. Mag.* 9. *pp.* 834–842, *May*, 1930. *Supplement.*

By sounding a note for one minute and then silencing it the sensitivity of the ear for the same note is reduced at first and subsequently enhanced. There are several such oscillations. The author quotes a case where there was a reduction immediately after stimulation, followed by normal sensitiveness after 7 min., and an enhanced sensitivity after 10 min. In 15 min. normality had been restored. Hearing is in this respect analogous to the action of muscles and glands as well as the other senses. E. E. F. d'A.

3783. Currents Produced by an Oscillating Plate. J. G. Roussakoff. *J. de Physique et le Radium*, 1. *pp.* 206–210, *June*, 1930.

The motion of lycopodium in the air above a vibrating plate (Savart), and of lycopodium in a drop of water on the plate (Strehlke) is described. The motion of the powder indicates that definite currents exist within the air and the water respectively. When fine sand is deposited in a 6 mm. layer of water on a plate the sand is moved, under the influence of vibration of the plate, towards the antinodes. This is illustrated for the case of a telephone disc, and the effects are explained by the action of Bjerknes' ponderomotive forces. G. E. A.

3784. Sensitive and Manometric Flames. R. C. Colwell. *Rev. Sci. Instruments*, 1. *pp.* 347–350, *June*, 1930.

The viscosity of gases varies widely and burners designed for one gas will not necessarily work well with another. The theory underlying the design of the five types described and diagrammatically illustrated is an extension of Tyndall's hypothesis. J. G. H. B.

3785. Elastic Impact of Pianoforte Hammer. R. N. Ghosh. *Phil. Mag.* 9. *pp.* 1174–1184, *June*, 1930.

The free vibration of the shorter portion of the string has been taken into account in calculating the pressure due to the impact. Sudden increases of pressure at intervals occur with a slightly elastic hammer but not with a very soft hammer. W. H. Ge.

3786. Automatic Reverberation-Measuring Instrument. M. J. O. Strutt. *E.N.T.* 7. *pp.* 280–282, *July*, 1930.

A microphone is connected to a powerful amplifier, the output of which is connected to a triode, the characteristics of amplifier and triode being so arranged that the latter is usually saturated when sound is picked up by the microphone. In the anode circuit on the saturated triode is a relay and a special timing device. In reverberation work, the sound picked up by the microphone maintains the anode current of the triode saturated until the sound intensity falls to a certain amount, when the anode current rapidly falls, thus operating the relay, and giving an accurate measure of the period of reverberation. Figures given in the paper for a certain case show a remarkable constancy of the measured period; in one series of experiments values of 1·74, 1·72, 1·72, 1·73, 1·73, 1·74, 1·72 and 1·73 sec. were obtained. The whole measuring equipment is very portable. G. E. B.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

3787. Electrostatics. R. Darbord. *Ann. de Physique,* 13. *pp.* 471–563, *May–June,* 1930.

In the measurement of the dielectric constants of liquids with h.f. by Nernst's bridge the liquid must be placed in a condenser with two boundaries, without guard-ring, which limits the precision of the measurements. The author has devised a new form of condenser which enables h.f. measurements to be made with the same accuracy that the guard-ring condenser affords in electrostatic measurements. A detailed description is given of this condenser which after preliminary calibration can be used as a standard in measurements of coefficients of induction. An accuracy of 1 part in 1000 is attained. The author develops his theory of the *electrostatic solid angle.* When the lines of force between two conductors are almost rectilinear a good method of approximation consists in assimilating the lines of force to circular arcs meeting the conducting surfaces normally. In the case of the electrostatic angle it is shown that the lines of force are rigorously circular. A study is given of the quadrant electrometer which is necessary in the method employed. In the second part of the paper the methods of Lord Kelvin for the measurement of the induction between two spheres and the theory of electric images are discussed and developed, and the calculation of the maximum field is applied to the study of the experiments of Abraham and Villard on the discharge between spheres at atmospheric pressure. J. J. S.

3788. Continuous Recording of Capacity Changes. A. Schulze and G. Zickner. *Arch. f. Elektrot.* 24. *pp.* 111–126, *June* 28, 1930. *From the Reichsanstalt.*

The author points out that many minute mechanical motions can be transformed into electrical variations and recorded by making use of capacity changes. For this purpose a Schering bridge, with a special condenser in one arm, is slightly unbalanced and the unbalanced bridge voltage applied to the grid of a grid-current rectifying triode valve, the anode circuit of which includes an electrical recorder. A linear relation between the change in capacity of the special condenser and the motion of the recorder pen is demonstrated and a method for altering the sensitivity of the device by adjusting the constants of the bridge is derived. L. E. C. H.

3789. Dielectric Polarisation of Liquids. Part IX. Electric Moments of the Alkyl Halides and Halogenated Methanes. C. P. Smyth and H. E. Rogers. *Am. Chem. Soc., J.* 52. *pp.* 2227–2240, *June,* 1930.

The electric moments of butyl chloride, bromide and iodide and heptyl bromide have been determined with a view to ascertaining the effect of the length of the hydrocarbon chain upon the moment of the molecule and to observing whether the variation from chloride to bromide to iodide is the same in large molecules as in small. The measurements of the dielectric constants and densities of the above products and also of the bromine and iodine substituted methanes have been made as in previous work [see Abstracts 2825 (1928) and 3508 (1930)]. The calculated polarisations show that the orientation or association of the polar molecules depends upon the size of the electric moments of the molecules and the screening of their doublets by the molecular structure. In the alkyl halides no measurable increase of electric moment accompanies increase of the number of carbon atoms beyond two. In the di- and tri-halogenated methanes, repulsive forces between the halogens distort the structures and reduce the moments of the molecules. H. H. Ho.

3790. Dipole Moments of Members of Homologous Series. P. C. Mahanti. *Phys. Zeits.* 31. *pp.* 546–555, *June* 1, 1930.

In previous investigations the dipole moments of a series of higher normal and iso-alcohols have been measured by a modified Nernst-Bridge method, when all saturated normal alcohols were found to have almost the same dipole moment, which is independent of whether the carbon chain be short or long, open or closed, and mainly due to the hydroxyl-group. It is concluded from a review of work in this field that in the case of members of homologous series which contain the same polar group, the dipole moments are practically equal. The dipole moments are now determined for the monohalogeno-derivatives of the paraffin homologues, *i.e.*, the substitution of a non-polar group for the polar hydroxyl group, by a modified Pungs-Preuner superposition method. The same dipole moment is found in each series containing the same halogen, but the moments of the halogeno-series differ from each other. Analogies are drawn between the dipole moments of the homologous series and dissociation energies of the inorganic halides calculated from the spectroscopic data and heats of formation. The order of magnitude is in all cases $Cl > Br > I$. H. H. Ho.

3791. Passage of Electricity through Solid Dielectrics. D. Nasledow and P. Scharawsky. *Ann. d. Physik,* 5. 4. *pp.* 429–452, *June* 18, 1930.

This paper contains a very complete introduction to previous work and then treats experimentally the phenomena observed in the passage of electricity through ceresin, a method for the measurement of polarisation being described. Very high polarisation voltages are found, although the ionised dielectric possesses a smaller polarisation than the non-ionised substance. In the region of 325–1600 volts a proportionality exists between the imposed voltage and the one due to polarisation. The data appear best explained on the theory of the ionic conductivity of solid dielectrics, and experimental confirmation by means of X-rays is submitted. H. H. Ho.

3792. Electrical Behaviour of Petroleum. P. H. Prausnitz. *Kolloid Zeits.* 51. *pp.* 359–360, *June,* 1930.

The present paper deals with the behaviour of technically pure water-free petroleum towards the direct electric current by means of the experimental arrangements used for observation of electroosmose. Not the slightest effect was observed with voltages up to 12,000. Only slight effects were obtained at very high voltages in electrophoresis experiments, so that the eletrokinetic phenomena, which are so typical in water, are practically absent in petroleum which consists of hydrocarbons of very low dielectric constant. It is noteworthy, however, that the glass powder used in the electrophoresis experiments exhibited a tendency to wander to the anode as in water, and this constitutes an exception to the Coehn rule. H. H. Ho.

3793. Field Distribution in Transformer Oils of High Insulating Quality, and Those with Small Conductivity. H. Schaefer. *Zeits. f. Physik,* 62. 9–10. *pp.* 585–591, 1930.

Describes a ballistic compensation method, which makes it possible to measure the distribution of the field between two oppositely charged parallel plates in the transformer oils by means of a plane probe electrode placed between them and parallel to them. Some of the oils tested were rendered slightly conducting by different added substances, and it was found that, while for these the potential of the probe electrode fell off linearly as it was moved from one side of the condenser to the other, there were small variations from linearity near the main electrodes in the case of the highly insulating oils. Different suggestions are made as to the reason for this behaviour; the author considers that the most probable is that highly insulating dielectric liquids behave in many ways like gases, and that, just as in gases, there is a lack of ions of the same sign as the electrode in the immediate neighbourhood of each electrode, with the result that the change of potential near the electrodes is more rapid than in the middle of the gas condenser, so a similar action may explain the observed potentials in the highly insulating oils. H. N. A.

3794. Vertical Electric Currents below Thunderstorms and Showers. T. W. Wormell. *Roy. Soc., Proc.* 127. *pp.* 567–590, *June* 2, 1930.

Measurements obtained by methods described in an earlier paper [see Abstract 2964 (1927)] have been extended over two years and the amounts of positive and negative and net upward positive discharge are tabulated with the corresponding weather conditions. These confirm the earlier conclusions regarding the predominance of positive upward electric currents and that negative potential gradients are much more marked for very intense fields. The majority of shower clouds are found to have a positive electric moment, thus confirming the conclusions of Appleton, Watson-Watt, Herd and Schonland. Finally the main processes of interchange between the air and the earth are considered when account is taken of (1) the ionisation current in fine weather, (2) convection of electric charges by precipitation, (3) charges transferred by lightning discharge and (4) currents caused by point discharge in periods of disturbed weather conditions. R. S. R.

3795. New Relation between Atmospheric Electricity and Terrestrial Magnetism. A. W. Lee. *Meteorolog. Office, Prof. Notes, No.* 58. [8 *pp.*], 1930.

As a measure of atmospheric electrical activity the "variability," defined as the sum (irrespective of sign) of the differences between successive hourly readings for the day, is taken. This, for electrically quiet days, for the years 1927–1928 at Lerwick and 1906–1928 at Kew, is shown to vary similarly to the potential gradient. The variability at Kew for the same period is then compared with the sunspot number for international magnetically disturbed (D) and quiet (Q) days, whence it appears that there has been a tendency for the electrical variability on D days to vary directly, and for that on Q days to vary inversely with sunspots, the coefficient of correlation between the D–Q difference and sunspot number being 0·48 ± 0·16. C. A. S.

3796. Hertz's Equations and Their Solution for the Outer Magnetic Field of the Earth. A. Sloutschanowsky. *Gerlands Beitr. z. Geophys.* 26. 3. *pp.* 333–350, 1930.

The equations are solved for the following conditions: a homogeneous medium rotates at a low constant angular speed about one axis which, in turn, rotates about another fixed axis. The field considered lies between two concentric spheres. The results obtained may be regarded as a contribution to the theory of the earth's magnetic field within the space between the earth's surface and the upper layers of the atmosphere. G. E. A.

3797. Possibility of an Equivalence between Electrical and Centrifugal Fields, and between Magnetic Fields and Corioli Fields. M. Hirsch. *Zeits. f. Physik*, 62. 9–10. *pp.* 640–645, 1930.

Since the centrifugal terms of the sun and the earth are related to one another as their electrical charges and, according to Angenheister, the mechanical rotational impulses of these two bodies are related to one another as their magnetic moments, it is proposed to investigate experimentally whether these relations are of a general nature—that is to say, whether general relations of equivalence exist between mechanical inertia fields and electromagnetic fields. H. N. A.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

3798. Electrical Surface Conductivity of Pressed Amber. E. Leiste. *Zeits. f. Physik*, 62. 9–10. *pp.* 646–672, 1930.

The insulation due to the material "pressed amber" now employed in electrometers depends, in moist air, more on its surface conductivity than on its volume conductivity, the latter being very small. Measurements are described in which the whole question was investigated, and the resistance measured for different air humidities. It was found that in addition to the known dielectric polarisation current from the volume of the amber, there may be a surface polarisation current dependent on the humidity, and this has been accurately investigated. It is ascribed to the action of adsorbed water films. H. N. A.

3799. Conductivity of Crystals. A. Joffe. *Zeits. f. Physik*, 62. 11–12. *pp.* 730–745, 1930.

Experiments on silver halides and other compounds show that looseness or otherwise of physical structure has no influence on electrical conductivity, as supposed by Smekal. The whole of the conductivity must be ascribed to the lattice ions, and irregularities are due to chemical impurities. E. E. F. d'A.

3800. Dependence on Pressure of the Electric Conductivity of Metals at Low Temperatures. U. Fischer. *Zeits. f. phys. Chem.* 8. *Abt. B.* 3. *pp.* 207–217, *June*, 1930.

The dependence on pressure of the electric conductivity of lead, tungsten, molybdenum, copper, iron, and constantan was measured at various temperatures down to the temperature of liquid hydrogen. The pressure coefficient of the resistance increases strongly with falling temperature, and the more so the higher the characteristic temperature of the substance is. With constantan, however, the pressure coefficient passes through a minimum at about 145° Abs. and at the temperature of liquid H reaches nearly the same value as at room temperature. J. J. S.

3801. Resistance Changes of Bismuth Crystals in a Magnetic Field at the Temperatures of Liquid Hydrogen and Liquid Nitrogen. L. Schubnikow and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 33. 5. *pp.* 418–439, 1930. *Comm. No.* 210*a and* 210*b from the Phys. Inst., Leiden.*

A very carefully prepared bismuth crystal has been tested at the temperature of liquid hydrogen. The absolute values of $R_H/R_{0°C.}$ were higher than those obtained with previous crystals, which were less perfectly purified; the curves obtained were, however, quite similar to those for the previous crystals. Crystals tested at the temperature of liquid nitrogen gave rotation diagrams which only had one maximum for $R/R_{0°C.}$ between the angles of rotation $-30°$ and $+30°$, the curve somewhat resembling a sine curve. [See also Abstracts 2905 and 3209 (1930).] H. N. A.

3802. Electrical Conductivity of Ferromagnetic Materials in Longitudinal Magnetic Fields. O. Stierstadt. *Phys. Zeits.* 31. *pp.* 561–574, *June* 15, 1930.

Gives details of the methods of measurement employed. A longitudinal magnetic field, acting on iron and nickel, always increases the electrical resistance. Resistance hysteresis curves are obtained for $dw/w_0 = f(\mathrm{H})$, which show the same typical appearances as magnetic hysteresis loops, with resistance-remanence, coercive force, etc. The alteration in the resistance can be represented in dependence on the magnetic flux B, $dw/w_0 = f(\mathrm{B})$; the relative alteration in resistance is, to a first approximation, proportional to from the third to the fourth power of B. The curves showing the relation between dw/w_0 and B also show narrow loops, something like hysteresis curves, which may be perhaps explained by mechanical alterations of structure, caused by some such action as magnetostriction, though they may be due to experimental error. H. N. A.

3803. Electrical Resistance of Gold in Magnetic Fields at Low Temperatures. W. Meissner and H. Scheffers. *Phys. Zeits.* 31. *pp.* 574–578, *June* 15, 1930. *From the Reichsanstalt.*

The authors reply to recent remarks by Kapitza [see Abstract 2907 (1930)] on their previous paper. They show that Kapitza's method of drawing the asymptotes, in the $\Delta R/R_0$ — K-Gauss curve, would lead to the conclusion that their specimen was less pure than a specimen of Kapitza's, while as a matter of fact it was much purer. Certainty can be obtained by measurements with higher field intensities, which are being undertaken. In any case it is not considered that the results obtained are compatible with Kapitza's hypothesis. The question of superconductivity is again discussed, and the theory of Grüneisen is considered to give a more satisfactory explanation than that of Kapitza. The difficulties in the former theory, however, first begin when the attempt is made to obtain from it quantitative statements about the sudden disappearance of the resistance, and the effect of a magnetic field. H. N. A.

3804. Potential Jump at Passage of a Spark. O. Mayr. *Arch. f. Elektrot.* 24. *pp.* 15–21, *June*, 1930.

Rogowski and Tamm [see Abstract 574 (1929)] have shown from a series of oscillograms of spark discharges that the potential jump at the passage of the spark is not instantaneous, but takes a certain small interval of time. Further work carried out at the high potential laboratory of the

A.E.G. and described in the present paper shows that the duration and height of the potential step observed at the passage of a spark is determined by the current strength in the spark and the stationary breakdown voltage. The product of the time duration of the potential step and the current strength in the spark is found to be approximately constant and has a value of about 100 microcoulombs per 1 cm.^{2} electrode surface. The height of the potential step with cold electrodes and a homogeneous field is about 65 % of the stationary discharge potential. A. W.

3805. Kathode-Ray Oscillograms of Electric Breakdown with Static Potential. W. Rogowski and H. Klemperer. *Arch. f. Elektrot.* 24. *pp.* 127–128, *June* 28, 1930.

An oscillogram is given of the voltage across a spark gap in air at atmospheric pressure when breakdown occurs with static potential. With surge potentials the fall of potential when the spark commences appears to start quite sharply, but with static potentials there is a slight rounding at the head of the slope, which is traversed in about 2×10^{-8} sec. The potential then oscillates several times. The breakdown of a spark gap in air at atmospheric pressure and about 9000 volts is for static potential not quite so rapid, but approximates to that for surge potentials. [See Abstracts 3191 (1927) and 181 (1928).] **Errata,** *ibid.* p. 258, Aug. 23, 1930. A. W.

3806. Sparking Potentials at Pressures Below Atmospheric Pressure, and Minimum Potential with Respect to Electrode Function. F. Klingelfuss. *Zeits. f. Physik,* 62. 7–8. *pp.* 569–584, 1930.

The paper is a continuation of previous work [see Abstracts 3130 and 3392 (1929)]. Numerical values are obtained for various universal constants as under:

e	Unit of negative electricity (from previous papers) ..	$4{\cdot}77465 \times 10^{-10}$ e.s.u.
	(recalculated in this paper)	$4{\cdot}774647 \times 10^{-10}$ e.s.u.
m'	Unit of free magnetism	$14{\cdot}32395$ e.s.u. $= 4{\cdot}77465 \times 10^{-10}$ e.m.u.
e'	Unit of positive electricity..	4108×10^{-10} e.s.u. $= 12324{\cdot}2$ e.m.u.
σ	Stefan's constant..........	$5{\cdot}8843 \times 10^{-5}$ erg/cm.^{2}/sec./(°C.)^4.
k	Entropy constant	$1{\cdot}36935 \times 10^{-16}$ erg/°C. (e.m.u.).
h	Planck's constant	$6{\cdot}538163 \times 10^{-27}$ erg-sec.
R_{He}	Rydberg constant for helium	$109679{\cdot}9$.
$\Delta\nu_H$	Doublet separation for hydrogen	$0{\cdot}36513$ cm.$^{-1}$.

J. H. A.

3807. Kathode Disintegration at Very Small Gas Pressures. A. Güntherschulze and K. Meyer. *Zeits. f. Physik,* 62. 9–10. *pp.* 607–618, 1930.

The disintegration of copper and silver kathodes is studied in He, Ne, A, H_2 and N_2 at pressures at which none of the disintegrating atoms gets back to the kathode. In argon this happens at a pressure of 0·01 mm., since below this pressure the mass disintegrated is independent of the pressure. In helium no disintegration takes place, at all events, up to 800 volts. The efficiency of disintegration varies from $\frac{1}{3}$ to 1 %.

E. E. F. d'A.

3808. Measurements of Langmuir's Dark Space. A. Güntherschulze. *Zeits. f. Physik,* 62. 9–10. *pp.* 619–623, 1930.

The Langmuir dark space was produced in an incandescent discharge of several amperes, in He, Ne, A and H_2, at an auxiliary plane kathode of tantalum, magnesium or tungsten, the potential of which was made negative with respect to the surrounding portion of the discharge. The thickness of the dark layer was measured for the different cases with relation to the pressure of the gas and to the voltage. To a large extent the electrons of the main discharge are kept out of the Langmuir zone by the field round the probe electrode, and the current is mainly carried by positive ions, which do not excite the gas molecules on collision to any great extent. A simple formula is given for the thickness of the zone for low gas pressure and small electric tension, and a series of tables shows how the measured thickness, under different conditions, compared with the calculated thickness. The results confirm the theory fairly well. Apparently with a magnesium kathode in hydrogen the kations are atomic and not molecular. With a magnesium kathode in argon, and with high voltages, a considerable portion of the current is conveyed by electrons from the kathode. [See also Abstract 1576 (1930).] H. N. A.

3809. High-Frequency Discharge. Part I. Air, Nitrogen and Oxygen. B. D. Chatterjee. *Zeits. f. Physik,* 62. 9–10. *pp.* 712–718, 1930.

Explains the different methods used for producing the discharges. The general results obtained were similar in the three gases and are illustrated by reproductions of photographs for different gas pressures in air and oxygen. The striæ and dark spaces, which depend upon the pressure of the gas, alter their appearance with the frequency with constant pressure. H. N. A.

3810. Corona Discharge at Large Gap Widths in Air. T. Nishi and Y. Ishiguro. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 253. *pp.* 276–282, *June* 20, 1930. *In English.*

A description is given of an experimental investigation of the effects obtained with alternating fields applied to gaps of from 10 to 80 cm., a disc electrode always being employed for the high potential side and the other electrode being either a needle point or a sphere. Spheres from 1 to 12·5 cm. diameter were used. A. W.

3811. Theory of Passage of Swift Corpuscular Rays through Matter. H. Bethe. *Ann. d. Physik,* 5. 3. *pp.* 325–400, *June* 10, 1930.

The inelastic impact of a swift, charged particle (electron, proton or α-particle) with an atom is treated mathematically on the basis of the wave mechanics theory of Born. A simple method is given for the evaluation of the matrix elements considered in the theory, and the close connection with the intensity of the Compton effect is shown. The theory is applied in particular to impacts with hydrogen atoms and also, as far as possible, to impacts with complicated atoms. Calculations are made of (1) the angular distribution of the inelastically and of the elastically scattered particles, (2) the excitation of spectrum lines and of Röntgen rays, (3) the total number of all inelastic and all elastic impacts, as well as the number of primary and secondary ions, (4) the velocity distribution of the secondary electrons, and finally (5) the retardation of the striking particles by gaseous atoms. Fair agreement is found between the calculated values and those obtained experimentally. [See Abstract 932 (1929)]. A. W.

3812. Form of Hydrogen Responsible for Striations in Hydrogen Discharge. L. Ebeler and E. Hiedemann. *Ann. d. Physik*, 5. 5. *pp.* 625–643, *June* 28, 1930.

The blue and red striations in the hydrogen discharge are associated with increases in the relative intensity of the continuous and the Fulcher bands respectively. It is suggested that the striations are due to the hydrogen molecule rather than to the atom. It is not possible to say what state of the hydrogen molecule is responsible. F. J. W.

3813. Loss of Velocity of Hydrogen Canal Rays by Passage through Solid Bodies. A. Eckardt. *Ann. d. Physik*, 5. 3. *pp.* 401–428, *June* 10, 1930.

The loss of velocity of homogeneous hydrogen canal rays in passing through thin celluloid and through metal foil was investigated experimentally. For canal rays of velocity corresponding to potentials from 30 to 50 kV and foils of thickness (σ) from 15 to 350 $\mu\mu$, it was found that the loss of velocity (Δv) could be represented by the formula $\Delta v = c\sigma$, where c is a constant depending on the material. Such a loss of velocity corresponds to a loss of energy which increases with the velocity of the individual canal-ray particles. The difference between the results for canal rays and those obtained for α-particles are explained by means of Thomson's theory of ionisation by collision. A. W.

3814. Coherence Length of the Light Emitted by Canal Rays. H. Straub. *Ann. d. Physik*, 5. 5. *pp.* 644–656, *June* 28, 1930.

Interference experiments were carried out by a method with a rotating mirror similar to that used by E. Rupp [see Abstract 1436 (1926)]. The results were contrary to those obtained by that observer. The coherence length of the light sent out by an unhomogeneous canal ray is actually smaller than that from glow light: it amounts to 2 mm. at the highest. An abnormal enlargement of the H lines was not found. J. J. S.

3815. Ionisation and Range of Hydrogen Canal Rays in Air and Hydrogen. C. Gerthsen. *Ann. d. Physik*, 5. 5. *pp.* 657–669, *June* 28, 1930.

Measurements of the ionising power of hydrogen canal rays in air and hydrogen were made for the velocities corresponding to potentials from 20 to 60 kV. The range of the hydrogen canal rays was also determined. The results show that within 2 % the range is proportional to the 1·5th power of the velocity. The apparatus used was similar to that employed in previous work. [See Abstract 1971 (1930).] A. W.

3816. Recombination of Ions in Air and Oxygen in Relation to the Nature of Gaseous Ions. O. Luhr. *Phys. Rev.* 35. *pp.* 1394–1404, *June* 1, 1930.

Uses an improved form of the apparatus described by L. C. Marshall [see Abstract 504 (1930)]. The value of the coefficient α does not become constant after a short time, as indicated by Marshall, but continues to fall off quite rapidly. A new system of calculation is employed, and α is found as a function of the age of the ions τ, rather than of t the total time of recombination. The results can be explained for air by supposing that heavy, slow-moving ions are gradually formed by reactions with impurities. It is possible that the ionising agent produces nitric oxides, O_3 or H_2O_2, which load up the ions. The other disturbing factor is the initial non-random distribution of the ions, which makes α large at first.

When these two factors have a minimum effect $\alpha = (1 \cdot 4 \pm 0 \cdot 1) \times 10^{-6}$, which is given as the closest approximation to an absolute value. H. N. A.

3817. Residual Ions in Intermittent Glow Discharge. A. J. Rothe. *Phys. Zeits.* 31. *pp.* 520–539, *June* 1, 1930.

Previous work by Geffcken and by Mauz and Seeliger is first discussed. From this it appears that in the intermittent h.f. glow discharge, a lowering of the probe potential is caused by the presence of residual ions which are produced in the immediately preceding partial discharge and continue to exist in the discharge space. The experimental conditions render the existence of such residual ions after the lapse of 10^{-2} to 10^{-3} sec. improbable, since the theory of ionic mobilities shows that they should completely disappear in 10^{-5} sec. Experiments were carried out in a transverse magnetic field to investigate this problem. The results obtained led to the assumption that the residual ions are derived from double layers which are built up during each discharge at the kathode and are disintegrated in the succeeding pause. This results in a relatively slowly decaying current of discharge carriers (ions and electrons, of which the latter are capable of producing ionisation by collision in sufficiently strong fields) in the discharge space. This assumption was tested by varying the experimental conditions in several ways and the results obtained showed that it would explain the observed effects. The results led to the further assumption that only the unstable element of the double layer is concerned in the disintegration, so that only in the case of very short discharge pauses does a lowering of the probe potential occur, while with longer pauses the normal effect of the double layer is a raising of the probe potential. In this way a simple and concise explanation is obtained of the whole behaviour of the probe characteristic. A. W.

3818. Loss of Electrons by Collisions with Positive Ions at Low Gas Pressures. A. Güntherschulze. *Zeits. f. Physik,* 62. 9–10. *pp.* 600–606, 1930.

The influence of potential and nature of gas present on the number of electrons lost by collision with positive ions at a copper kathode has been studied by a thermal method. The number of electrons lost decreases as the potential is decreased and becomes less as one passes from helium through neon to argon. F. J. W.

3819. Collisions Between Positive Ions and Atoms. F. M. Penning and C. F. Veenemans. *Zeits. f. Physik,* 62. 11–12. *pp.* 746–763, 1930.

The losses of energy suffered by positive ions of K and A in traversing argon at 200 volts are compared. It appears that the potassium ions lose much less and the argon ions much more energy than the amount required by gas theory. The cause is sought in a reversal of the charge of the A ions. Experiments with a mixture of 90 % neon and 10 % argon lead to the same conclusion. E. E. F. d'A.

3820. Electronic Conduction and Ionisation in Crossed Electric and Magnetic Fields. N. Minorsky. *Frank. Inst., J.* 209. *pp.* 757–775, *June,* 1930.

Mathematically investigates electronic conduction and ionisation in crossed electric and magnetic fields, considering trochoidal scattering of electrons with the length of one trochoidal loop small compared with the mean free path. The geometry of the trochoidal scattering of electrons in crossed fields is first discussed. In order to establish the conditions of distribution of electrons in various virtual trochoidal trajectories the results obtained from the first part are supplemented by statistical considerations. This, however, is not complete, as no allowance is made for space charge, this being obtained by the introduction of the probability of collision depending on the mean free path. It is shown that the potential difference across the gas in which the trochoidal field of electronic trajectories is established depends on two independent parameters. Finally, the investigation is extended to take into account the case of non-elastic impacts or ionisation in crossed fields. R. C. F.

3821. Critical Potentials of the Hydrogen Molecule. J. E. Roberts. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 39–45, *April*, 1930.

The observed critical potentials of the hydrogen molecule are considered in the light of the potential energy curves for the various states and the Franck-Condon principle. The most probable energy change requires 12·8 volts, though this is not, strictly speaking, a critical potential, the latter being in the regions of 11 and 12 volts. A further potential between 8 and 9 volts reported by Jones and Whiddington [see Abstract 931 (1929)] is probably due to the excitation of the triplet states, with subsequent dissociation of the molecule and emission of the continuous spectrum. AUTHOR.

3822. Electron Impacts in Argon. J. E. Roberts and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 46–49, *April*, 1930.

Experiments on electron impacts in gases, of the type described in previous communications [see Abstract 2285 (1930)], have been made, using argon. Energy losses are found at 11·6, 13·0 and 14·1 volts. Fundamental differences in the appearance and width of "loss lines" obtained in diatomic and monatomic gases are described and discussed in the light of the theory of atomic and molecular electronic levels. AUTHORS.

3823. Energies of Electrons in Gases. J. S. Townsend. *Phil. Mag.* 9. *pp.* 1145–1173, *June*, 1930.

A general discussion is given of the results of certain experimental investigations of the electrical properties of gases which have been carried out at the Electrical Laboratory, Oxford, and from this discussion it is shown that the laws of impacts of electrons on atoms of monatomic gases as given by Franck and Hertz are not in agreement with the electrical properties of currents in wide tubes as found experimentally. Also, as far as radiation from the gas is concerned, these laws are unsatisfactory, since they indicate that the lines in the visible spectrum of monatomic gases would not be excited, under the conditions in which bright luminous columns of gas are obtained in discharge tubes. It is also pointed out that these modern theories of critical potentials are not based on reliable experimental evidence. The latter part of the paper discusses the energy of agitation of the electrons in helium and neon, and the disturbing effects which cause some of the electrons to have energies which exceed the mean energy by definite factors. The motion due to diffusion is investigated and it is shown that there are wide differences in the velocities of different groups of electrons in the direction of an electric force, which are accompanied by large inequalities in the amounts of energy lost by the different groups. Various points of interest in connection with the method here developed of investigating the distribution of energy among the electrons will be considered in a subsequent paper. A. W.

3824. Scattering of Electrons by Atoms. N. F. Mott. *Roy. Soc., Proc.* 127. *pp.* 658–665, *June* 2, 1930.

The author obtains formulæ for the scattered intensity of the electron stream by methods similar to those used for the scattering of X-rays by an atom. They have been published elsewhere by the author or by others; but the analysis used in the present method is particularly simple, and makes it clear under what conditions the approximations used will give a sufficiently accurate result. It is assumed that a beam of particles, all with the same energy, behaves like a beam of waves, the rate of flow of the particles being proportional to the square of the amplitude of the waves. The law that determines how these waves are scattered is deduced from the wave equation; this can be solved exactly for the scattering of a beam of charged particles by an inverse square centre of force, so that the amplitude and phase of the scattered wave can be calculated. This leads to a formula for the scattering of electrons by atoms. The formula assumes that the amplitude and phase of the wave inside the atom are not much disturbed, and that the effect of the polarisation of the atom by the incident electron can be neglected; the result is that the formulæ can only be regarded as valid for electrons of greater energy than that of a K electron in the atom. The result has been compared with experimental data from two different sources, and satisfactory agreement has been found. H. N. A.

3825. Scattering of Fast Electrons and Nuclear Magnetic Moments. H. S. W. Massey. *Roy. Soc., Proc.* 127. *pp.* 666–670, *June* 2, 1930.

Considers the possible effect of a nuclear magnetic moment, and finds that it is negligible for any probable value of the magnetic moment. H. N. A.

3826. Penetration of a Potential Barrier by Electrons. C. Eckart. *Phys. Rev.* 35. *pp.* 1303–1309, *June* 1, 1930.

A potential barrier of the kind studied by Fowler and others [see Abstracts 2172 (1928) and 1959 (1929)] may be represented by the analytic function

$$V(x) = -A\xi/(1-\xi) - B\xi/(1-\xi)^2, \quad \xi = exp(2\pi x/l).$$

The Schrödinger equation associated with this potential is soluble in terms of hypergeometric functions, and the coefficient of reflection for electrons approaching the barrier with energy W is calculable. The approximate formula

$$1 - \rho = exp\left\{-\int\frac{4\pi}{h}(2m(V-W))^{\frac{1}{2}}dx\right\}$$

is shown to agree well with the exact formula when the width of the barrier is great compared with the de Broglie wave-length of the incident electron and $W < V_{max}$. E. E. F. d'A.

3827. Variability of the Number of Free Metal Electrons with Temperature. H. Margenau. *Phys. Zeits.* 31. *pp.* 540–546, *June* 1, 1930.

With the help of Fowler's formulation of quantum statistics a mass action law is obtained which the metal atoms obey at their dissociation into ions and free electrons. A simple condition is that the aggregate includes free electrons. The dependence on temperature of the number of the free electrons at various possible values of the ionisation potential and the emission work was investigated, and it is found that this number may practically be treated as constant. J. J. S.

3828. Application of Generalised Statistics to Thermal Ionisation. K. C. Kar and A. Ganguli. *Zeits. f. Physik*, **62.** 7–8. *pp.* 510–517, 1930.

The thermal ionisation formula of Saha and the thermionic emission equation of Richardson have been developed using a statistical method.
F. J. W.

3829. Rôle of the Core Metal in Oxide-Coated Filaments. E. F. Lowry. *Phys. Rev.* **35.** *pp.* 1367–1378, *June* 1, 1930.

The large differences between two types of oxide filament, one having a core of nickel alloy and the other one of platinum-iridium, necessitates the conclusion that the core metal has a definite function other than simply a mechanical support for the alkaline earth oxides. In order to account for this difference, a modification is suggested in existing ideas concerning the mechanism of emission from this type of kathode. This modification consists in assuming that the source of emission is the composite layer formed by occlusion of alkaline earth metal on the surface of the core and that the electrons emitted diffuse through the interstices in the oxide coating into the vacuous space. Argument is presented to show that this explanation will also account for other peculiarities in the behaviour of oxide kathodes. E. E. F. d'A.

3830. Electron Emission from Oxide Kathodes. A. Gehrts. *Zeits. f. techn. Physik*, **11.** 7. *pp.* 246–253, 1930.

The electronic emission of oxide kathodes is an emission of glow electrons from metallic barium or other alkaline earth metal adsorbed by the oxide surface, the metal being produced by thermal dissociation. During the process of activation the dissociated oxygen is entirely removed from the kathode. To facilitate activation the core metal is mixed with more easily oxidised constituents like iridium, rhodium or nickel.
E. E. F. d'A.

3831. Systems with Especially Small Asymmetric Exit-Work for Electrons. W. Ostwald. *Kolloid Zeits.* **51.** *pp.* 370–376, *June*, 1930.

The author discusses certain types of electrical rectifiers, contacts for heterogeneous catalysis and photocells, indicating the striking analogies which exist. Certain systems, such as $Cu + Cu_2O$ or $Pt + H_2$, which are effective under all three circumstances above, are fully described. The Mittasch contact ($Fe + Al_2O_3 + K_2O$) is also shown to be available as a glow-electrode rectifier. H. H. Ho.

3832. New Photoelectric Cell. T. Asada. *Phys. Math. Soc., Japan, Proc.* **12.** *pp.* 145–155, *June*, 1930. *In German.*

The cell is a kind of triode with a central filament of incandescent nickel wire coated with salts of calcium, strontium, and barium. These substances evaporate, and are deposited upon a spiral grid surrounding the filament. The grid is light-sensitive when gently heated, and shows no photoelectric fatigue as the sensitive substance is continually renewed from the filament. The cell gives about a thousand times the effective current of an ordinary cell, and reacts to visible and infra-red rays, and probably also to the ultra-violet. E. E. F. d'A.

3833. Photoelectric Cell for the Ultra-Violet and its Sensitisation. H. Hulubei. *Comptes Rendus*, 190. *pp*. 1549–1552, *June* 30, 1930.

The metal employed in the cell was palladium, the threshold of which makes it possible to work in the middle ultra-violet without being disturbed by the visible spectrum or the long wave-length ultra-violet. The palladium was deposited on a strong silver support. The window of the bulb was of quartz. The palladium was sensitised by the action of atomic hydrogen produced either by Wood's method or by that of Franck and Cario. Working below the maximum sensitiveness the stability was good. H. N. A.

3834. Thallofide and Selenium Cells. R. Sewig. *Zeits. f. techn. Physik*, 11. 7. *pp*. 269–273, 1930.

Describes thallium cells made after the method of Majorana and Todesco [see Abstract 2275 (1929)], in imitation of T. W. Case, and compares their performance with cells made by Radiovisor, Thirring and Case respectively. In these new thallofide cells, made by the Osram Company, the photoconductivity is practically proportional to the light-intensity up to 300 lux. The current increase on sudden illumination takes only 0·01 sec. to reach a steady value. There is a logarithmic relation between resistance and e.m.f. The spectral maximum lies at 1·05 μ. E. E. F. d'A.

3835. Internal Photoelectric Effect in Crystalline Semi-Conductors. I. Runge and R. Sewig. *Zeits. f. Physik*, 62. 11–12. *pp*. 726–729, 1930.

The behaviour of thallofide cells is studied theoretically on the basis of Gudden's conception of secondary conductivity in crystals. Curves are obtained which closely agree with experimental ones. E. E. F. d'A.

3836. Photo-Conductance Phenomena in Silver Halides and the Latent Photographic Image. F. C. Toy and G. B. Harrison. *Roy. Soc., Proc.* 127. *pp*. 613–637, *June* 2, 1930.

The formation of the latent photographic image and the photoconductance phenomena in silver bromide were investigated under different conditions of crystallisation and from room-temperature to − 180° C. If the AgBr is exposed in such a way that no permanent decomposition can take place the photo-current very probably commences to flow at the instant of illumination, and within about 0·07 sec. rises to a constant final value which is strictly proportional to the light-intensity. On varying the temperature and the conditions of crystallisation there are indications that in all probability the photo-current is electronic. Thus latent image-formation is probably not due primarily to elementary electrolytic photo-currents in the AgBr crystals but rather to the momentary change in the light of some of the bromide ions into free bromine atoms, which are not present in the dark and which react with other atoms or molecules such as those in the surrounding gelatin. A permanent change thus takes place, metallic silver being one of the resulting products. J. J. S.

3837. Photoelectric Method of Integrating Sunlight. J. A. C. Teegan and G. R. Rendall. *Indian Journ. Phys.* 4. *pp*. 585–589, *June* 30, 1930.

The authors, in place of the Burt sodium cell used by Atkins and

Poole [see Abstract 1853 (1929)], employed a comparatively insensitive potassium cell combined with a valve amplifier. The details of the apparatus and the methods employed are described in some detail, and it was found that whereas with the Burt cell an illumination of 500 m.c. for 1 sec. produced a deposit of $1 \cdot 8 \times 10^{-10}$ gm. of copper, the present method produced a deposit of $8 \cdot 81 \times 10^{-10}$ gm. for the same illumination. J. G. H. B.

3838. Comparison of Piezoelectric Quartz Oscillators Vibrating with Small Frequency Differences. A. de Gramont and G. Marboux. *Comptes Rendus,* 190. *pp.* 1394–1395, *June* 16, 1930.

When the two quartz oscillators are tuned very close to one another the beats become very slow, and fall in the region of infra sounds, which can no longer be distinguished by the ear. An apparatus with an indicating needle is required to distinguish them, and this is sometimes not convenient. The superposition of the waves from the two quartz oscillators can, however, be considered as giving a single wave, the intensity and frequency of which vary periodically. If this complex wave is made to beat with a heterodyne adjusted to give an audible note (500 to 1000 periods) the resultant sound will vary in pitch, and these fluctuations are easy to hear. Their frequency is that of the beats between the two quartz oscillators. H. N. A.

3839. Approximate Evaluation of the Expression $\frac{J_0(x)}{xJ_0'(x)}$ in the Theory of Electrical Oscillations. W. Kessenich. *Ann. d. Physik,* 5. 5. *pp.* 606–610, *June* 28, 1930.

A discussion of the admissibility of various approximate solutions of this expression which frequently occurs in the theory of electrical oscillations. J. J. S.

3840. Van der Pol's Theory of Forced Oscillations. A. Andronow and A. Witt. *Arch. f. Elektrot.* 24. *pp.* 99–110, *June* 28, 1930.

A mathematical discussion is given of the problem of the suppression of free by forced oscillations in a valve circuit, an approximate theory of which has previously been given by van der Pol [see Abstract 1516 (1927)]. The present paper is based on Poincaré's treatment of non-linear oscillations. It is shown that the suppression effect always exists, however small the amplitude of the external periodic force, so that there is no threshold or critical value for the effect. It is further shown that the stable purely periodic solution with the period of the external force is the only stable solution. For sufficiently small amplitudes of the applied e.m.f. three singular points of the fundamental differential equation are found, but of these only one is stable. Outside the region where the suppression effect exists the differential equation gives only one singular point, where there is a cyclic limit; in other words, there exists a continuum of stable nearly periodic solutions of equal mean energy. The moment at which the stable periodic solution vanishes coincides exactly with the establishment of the stable nearly periodic solutions, so that there is no hysteresis on passing from one to the other. A. W.

3841. Magnetic Moments of Alloys and the Common Measure of Atomic Moments. R. Forrer. *Comptes Rendus,* 190. *pp.* 1284–1287, *June* 2, 1930.

When the numbers of magnetons in the moment of certain alloys of iron, cobalt, and nickel are plotted against the (atomic) percentage composition, the resulting curves consist of several straight lines meeting at definite angles. This is shown to be consistent with a theory that throughout the region indicated by one such straight line the atoms of one (or both) constituents, in steadily increasing number, change their moments by, in most cases, a definite whole number of magnetons, the extent of the change being measured by the slope of the line. C. A. S.

3842. Ferromagnetism of Alloys of Nickel and Chromium. C. Sadron. *Comptes Rendus*, 190. *pp.* 1339–1340, *June* 11, 1930.

The saturation values at absolute zero are determined from observations made between 110° K. and 150° K. for specimens containing from 1·5 to 8 % Cr. As the Cr content increases up to 6 % the saturation value diminishes linearly; thereafter the saturation value is greater than that given by the linear law. Also the Curie point falls as the Cr content increases. Extrapolation gives 0° K. for the Curie point when the alloy contains about 12 % Cr; for this alloy the magnetic moment is zero. G. E. A.

3843. Production by Heat Treatment of Two Different States of Pure Iron, which are Stable at Ordinary Temperatures. R. Forrer and J. Schneider. *Comptes Rendus*, 190. *pp.* 1391–1393, *June* 16, 1930.

Very pure electrolytic iron wire was heated for two hours to 400° C., for one hour to 600° C. and for 15 minutes to 900° C. The remanent magnetism after the heat treatments is small, from 200° to 400° C. From 450° to 900° C. the remanent magnetism is considerably larger, and shows a maximum for treatment at 660° C. This region of temperature appears to be favourable to the formation of a second modification of iron, the cycle of which has a characteristic form. It is stable at lower temperatures, once it is produced, showing a higher remanent magnetism than the original form. Certain impurities have been found to favour the production of this exceptional state. Gives a theory of the structure of the two forms of iron. The quantitative results deduced agree fairly well with the experiments. H. N. A.

3844. Coefficient of Magnetisation of Aqueous Solutions by the Falling Drop Method. L. Abonnenc. *Comptes Rendus*, 190. *pp.* 1395–1398, *June* 16, 1930.

The method, which has previously been described by the author [see Abstract 1883 (1926)], gives concordant results if confined to liquids with similar physical properties, such as water and aqueous solutions, using drops with regular frequency and a sufficient hydrostatic pressure. The susceptibility of water and of aqueous solutions of halogen salts and hydracids has been compared, and assuming a value for the susceptibility of air, the molecular susceptibilities of different compounds, including HCl, HBr and HI, can be calculated; making allowance for the apparent paramagnetism which the ion H^+ receives due to the alteration which it produces in the neighbouring molecules of water, the values of the diamagnetism of the ions Cl^-, Br^- and I^- can be determined. These agree excellently with those found by Hocart, which are probably the most accurate of those so far obtained, those for Br^- and I^- being deduced from measurements on the solid potassium salts. H. N. A.

3845. Diamagnetism and Molecular Structure. C. V. Raman. *Phys. Soc., Proc.* 42. *pp.* 309–320, *June* 15, 1930.

The author reviews work carried out by himself and his pupils relating to the diamagnetic characteristics of organic and inorganic substances, including crystals, liquids and gases. [See Abstracts 873 (1928) and 121 (1930)]. J. S. G. T.

3846. Experimental Investigation of Rotational Hysteresis Losses. K. Seiyama. *Kyushu Univ. Coll. Eng., Mem.* 5. 4. *pp.* 227–294, 1930. *In German.*

A long treatise on the subject utilising for the practical work a method previously published [see Abstract 761 (1923)]. Both by calculation and measurement of the eddy current losses three formerly investigated factors were further examined, *viz.* (1) the introduction of the body under test into the magnetic field causes no disturbance thereof, *i.e.* it remains constant; (2) the permeability of the test piece has the same value in both the statical and the rotating field; (3) the spherical and the cylindrical test pieces have the same specific conductivity and permeability. These assumptions were unavoidable. From the present work the following results may be noted: (1) The rotational hysteresis loss of iron and nickel increases with the induction up to a maximum value, after which it decreases until at high inductions it is approximately nil. (2) The maximum rotational hysteresis loss as also the statical hysteresis loss at very low values of the induction is equal to zero. (3) The maximum rotational hysteresis loss lies according to the induction at the bend or knee of the magnetisation curve. (4) At low inductions the rotational loss is somewhat greater than twice the static hysteresis loss. The paper is profusely illustrated by curves and diagrams. S. G. B.

3847. Magnetic Transformation of Regular Ferric Oxide. H. Sachse and R. Haase. *Zeits. f. phys. Chem.* 148. *Abt. A.* 6. *pp.* 401–412, *June*, 1930.

It is shown that regular crystals of ferromagnetic ferric oxide, Fe_3O_4, are unstable at all temperatures. The susceptibility of a product prepared in 1925, fell in the course of four years at room-temperature by 60 % of the initial value. This old material lost its magnetism in a few hours when heated to 400° C., while originally it did not change even when heated for several days to this temperature. The results of the investigation of the structure of the substance, which show that the change which takes place is a pseudomorphosis of the fine structure into magnetite (paramagnetic, trigonal), make clear the relation between ferromagnetism and the lattice type, and agree with the explanation given by Heisenberg of this property. H. N. A.

3848. Magnetic Instability in Cooling Phenomena. O. Tesche. *Zeits. f. techn. Physik*, 11. 7. *pp.* 239–242, 1930.

By cooling iron or nickel test pieces phenomena similar to the Barkhausen effect can be obtained. Various examples are described and the relation of these effects to other known phenomena are considered.

J. J. S.

3849. Electrical Units. R. Yoneda. *Electrot. Laborat. Tokyo, Japan, Circ. No.* 69. [88 *pp.*], 1930.

In the first part the author discusses the general problems of electrical units, such as principles of setting-up systems of electrical units, methods of classification, their mutual relations, comparisons of different systems, etc. These problems are not entirely new, and yet there appears to be no report of this kind available. In the second part he gives a brief historical survey of electrical units and standards and also describes the present state of the so-called international electrical units. AUTHOR.

3850. Measurement of Self-Induction by Pirani's Method. D. Guindin. *J. de Physique et le Radium*, 1. *pp*. 211–216, *June*, 1930.

In Pirani's method the self-induction to be measured is first balanced in a Wheatstone's bridge as a simple resistance, the battery key being pressed before that of the galvanometer and the extra current avoided. Then on reversing this order the extra current is shown and there is placed in series with the self-induction a resistance shunted by a condenser, and by trial the value of this resistance is found for which the extra current vanishes, the bridge being in equilibrium. Then the self-induction $L = Cr^2$, r being the shunted resistance and C the capacity of the condenser. But in practice the resistance placed in series is apt to diminish considerably the extra current. A modification, in which the shunted resistance is placed in the opposite arm of the bridge, is apt to diminish the scope of the orders of magnitude measurable. The author describes a new modification which avoids these inconveniences. In this a resistance is placed in derivation on the self-induction and the resistance in the opposite arm is shunted by a condenser. The theory of this method is given and also that of the previous arrangements. J. J. S.

3851. Connection Between the Emitted Energy and the Internal Electrical and Magnetic Fields of Radiating Matter. F. J. v. Wiśniewski. *Zeits. f. Physik*, 62. 9–10. *pp*. 682–686, 1930.

It is shown by the methods of classical electrodynamics that the energy emitted by a volume v_0 of a material medium is given by

$$\frac{v_0^2}{24\pi^2}\cdot\frac{1}{c^3}\left\{\sum_{s=1}^{3}(\mathrm{E}''_{0s})^2+\sum_{s=1}^{3}(\mathrm{H}''_{0s})^2\right\},$$

where E''_{0s} and H''_{0s} are the second derivates with respect to time of the components of the internal electric and magnetic fields. W. S. S.

APPARATUS AND INSTRUMENTS.

3852. Screened Bridge for the Measurement of Electrolytic Conductivity. Part I. Theory of Capacity Errors. Part II. Description of Bridge. T. Shedlovsky. *Am. Chem. Soc., J.* 52. *pp*. 1793–1805, *May*, 1930.

Earlier work on the accurate determination of electrolytic conductivity is reviewed and the errors and limitations are pointed out. The theory of earth and shield capacity effects on a.c. is discussed and the results are applied to the Wheatstone bridge. The principles for the design of an electrostatically screened bridge for the accurate determination of electrolytic conductivities are described. F. J. B.

3853. Valve Potentiometer for Determination of True E.M.F. of a High-Resistance Cell. R. J. Fosbinder. *J. Phys. Chem.* 34. *pp*. 1294–1302, *June*, 1930.

The theory and construction of a valve potentiometer for determining the true e.m.f. of a high-resistance cell have been described. Operating the amplifier under well-defined conditions an accuracy of ± 0·0001 volt is obtainable. AUTHOR.

3854. Kathode-Ray Oscillograph. M. Brenzinger. *Arch. f. Elektrot.* 24. *pp.* 80–87, *June* 28, 1930.

A description is given of a kathode-ray oscillograph outfit adapted for recording periodic phenomena. Details are given of the potential " kipp " arrangement by means of which a linear time base is obtained, the result being that the periodic effect under investigation produces a curve on the fluorescent screen which is accurately repeated for as long an interval of time as is necessary to obtain a good photograph. Extreme intensity of the kathode beam, such as is employed by Rogowski for observing transient phenomena, is not necessary for the purpose in question. Examples are given of oscillograms of the voltage given by a 50- and by a 500-∼ alternator, and also of the anode current of a 10,000-∼ valve generator and the potential of a 200-kc. valve generator. A. W.

3855. High-Resistance Leak for Electrometer Use. A. K. Brewer. *Rev. Sci. Instruments,* 1. *pp.* 325–328, *June,* 1930.

This paper briefly discusses the various types of resistors in use and describes a reliable one consisting of a lead pencil line drawn on a polished amber rod. The rod is from 1 to 2 in. long, tapered slightly at each end, and is heavily leaded for a distance of about $\frac{1}{8}$ in. from each end. The two leaded spots are joined with a pencil line with a 3H pencil. It is preferable to polish the ruling with a dry towel; this will, of course, cause an increase in the resistance. By washing the rod and the caps fitting on to its ends in alcohol, the resistor is made free from internal e.m.f.s. This type of resistor has a resistance of 10^9 to 10^{11} ohms and does not vary by more than 3 % in the undried condition; after drying and remaining in a drying tube it remains constant for months with a very small temperature coefficient. W. C. S. P.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3856. Micro-Radiography. A. Dauvillier. *Comptes Rendus,* 190. *pp.* 1287–1289, *June* 2, 1930.

It is found that the plates devised by Lippmann for interference colour photography, prepared according to the method of Watteville and Leroy, though, when used ordinarily, some one thousand times less sensitive than commercial plates, are substantially more so to direct darkening. The object to be examined, a few microns in thickness, is pasted directly on to the emulsion of such a plate, and exposed to soft X-rays, preferably by means of the apparatus for crystal analysis exhibited in 1929 at the exhibition of *La Société Française de Physique.* With this apparatus, with tungsten antikathode, 0·1 A and 7 kV, an exposure of 2 hours gives, with silver intensification, a satisfactory picture, capable of high magnification, *e.g.* to 600 times. C. A. S.

3857. Coolidge-Type X-Ray Tube Actuated at 400,000 Volts. A. d'Arsonval. *Comptes Rendus,* 190. *pp.* 1538–1541, *June* 30, 1930.

The earlier development of high voltage X-ray and kathode ray tubes is briefly mentioned. Hitherto the tubes have been for research purposes only. Gaiffe-Gallot and Pilon have constructed a practical X-ray tube, on the Coolidge principle, to operate at 400 kV. Brief particulars of the dimensions are given. The wave-length of the rays emitted are as short as 0·0308 Å. with a maximum emission at 0·0402 Å., and are shorter in wave-length than the radiation emitted from RaB and ThB. The protection necessary to the operators is four and five times greater than that necessary at 200 kV. B. J. L.

3858. Single Valve Plant for Diagnosis and Therapy. W. E. Schall. *Brit. J. of Radiology*, 3. *pp.* 274–278, *June*, 1930.

The entirely different requirements of X-ray therapeutic and X-ray diagnostic apparatus are mentioned. It is impossible to construct transformers which can be regulated to meet the two varying requirements. These requirements can, however, be fulfilled by the use of a dual circuit which, for diagnostic purposes, utilises single valve rectification (*i.e.* a single half-cycle of energy) and, for therapy, two condensers are switched in to form the Villard connection at a twofold tube potential. The connections to allow switching from one circuit to the other are described and, according to the particular purpose, the controls for the other method of operation are automatically cut out. B. J. L.

3859. Action Currents in the Auditory Nerve in Response to Acoustical Stimulation. E. G. Wever and C. W. Bray. *Nat. Acad. Sci., Proc.* 16. *pp.* 344–350, *May*, 1930.

A decerebrated cat under anæsthetic had its right auditory nerve exposed and electrodes were placed on the nerve and in other suitable locations. The currents picked up from these electrodes were conducted *via* 60 ft. of shielded cable to a valve amplifier located in a sound-proof room. The ear of the animal was then stimulated and it was found speech could be well conducted *via* the insensible animal's ear to the auditory nerve and then *via* the cable and the sound-proof room. The results show that the frequency of the nerve response is co-related to the frequency of stimulation and places difficulty upon acceptance of the modern Helmholtz theory of hearing in its present form, whilst it is in favour of the so-called telephone theory of audition. The precautions taken to exclude conduction being due to inductive effects, direct mechanical conduction and mechanical movements of, rather than conduction of, the nerve are detailed. One important control is the cessation of the conduction on the death of the animal. B. J. L.

3860. Electrical Hœmodromograph. P. Fabre. *Comptes Rendus*, 190. *pp.* 1321–1323, *June* 2, 1930.

An instrument is described and sketched to allow study of the flow of blood under physiological experimental conditions. The method utilised is to insert a composite ebonite and ivory tube in the vascular system of the animal under experiment. Upon an ivory plate a fixed and a movable electrode are mounted. The movable electrode varies in position according to the velocity of blood flow and, in consequence, the electrical resistance of the blood between the two electrodes varies. This variation of potential between the two electrodes is amplified by means of valve tubes and hence, after previous calibration, the instrument can give a permanent record of the variations of velocity of the blood flow, the usual precautions to avoid coagulation of the blood being taken. B. J. L

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3861. Adsorption Studies with the Rare Gases. K. Peters and K. Weil. *Zeits. f. phys. Chem.* 148. *Abt. A.* 1–2. *pp.* 1–26, *June*, 1930.

A method has been devised for the quantitative separation of argon, krypton and xenon, which depends upon a process of fractional desorption from activated charcoal. Further, the adsorption isotherms of the gases on charcoal have been determined for the temperatures 193°, 255° and 273° K. The results satisfy with sufficient accuracy the adsorption isotherm $a = \alpha \, . \, p^{1/n}$, where a is the amount adsorbed at a pressure p. F. J. W.

3862. Adsorption of Chlorine on Silica Gel. A. Magnus and A. Müller. *Zeits. f. phys. Chem.* 148. *Abt. A.* 4. *pp.* 241–260, *June*, 1930.

The adsorption of chlorine on silica gel is measured in glass apparatus without taps or mercury, using gravimetric methods. After equilibrium with the adsorbent has been established a measured volume of the free chlorine is condensed by means of liquid air and weighed, the adsorbed chlorine being determined in a similar manner, the adsorbent being heated to 200° C. Adsorption isotherms for 0°, 20° and 40° C., and for pressures up to 677 mm. mercury, are established. The differential heats of adsorption calculated from pairs of isotherms vary with temperature and pressure, as in other cases. [See Abstract 801 (1930).] A. J. M.

3863. Adsorption of Methane by Charcoal. J. N. Pearce and H. F. Johnstone. *J. Phys. Chem.* 34. *pp.* 1260–1279, *June*, 1930.

A study has been made of the adsorption of methane and its chlorine derivatives by activated charcoal at temperatures ranging from the lowest usable up to that of decomposition. The influence of successive substitution of chlorine atoms on various adsorption magnitudes has been noted and discussed. The potential distribution and the density distribution within the adsorption space have been calculated. In general, the results obtained are in harmony with the theory put forth by Polanyi and others that the adsorbed layer is more than one molecule in thickness. AUTHORS.

3864. Sorption by Charcoal of Gases and Vapours under Great Pressure. J. W. McBain and G. T. Britton. *Am. Chem. Soc., J.* 52. *pp.* 2198–2222, *June*, 1930.

Using the McBain-Bakr sorption balance the sorption of nitrogen, nitrous oxide and ethylene have been measured at pressures up to 60 atmospheres. The shape of the sorption isotherms obtained are the same whether the gas is above or below the critical temperature. A saturation value is found for all experiments with nitrous oxide and ethylene, whereas with nitrogen, saturation was only reached with steam activated charcoal. It is shown that the experimental data do not satisfy the theory of Polanyi which regards the adsorbed gas as existing in a highly compressed state. The authors are of the opinion that the Langmuir theory provides the best description of the data and show that the corresponding adsorption isotherm fits their figures accurately. F. J. W.

3865. Refraction of Electrons at the Gas Layer Adsorbed on Metals. E. Rupp. *Ann. d. Physik*, 5. 4. *pp.* 453–474, *June* 18, 1930.

The space lattice configuration on a number of metals was investigated by means of the refraction of electrons. The metals were nickel, iron, copper, molybdenum and zirconium. The inner space lattice potential was found to be 16·5 volts for nickel, 14·5 for iron, 12·8 for copper, 13·5 for molybdenum and 10·2 for zirconium. The internal space lattice potential showed no measurable change with the velocity of the electrons. Argon had no influence on the space lattice of nickel. Hydrogen produced a loosening of the lattices in the case of nickel and iron. The effects of time and temperature on this action were determined. The reaction between nitrogen and hydrogen at the loosened lattice of nickel and iron was followed, and the conditions requisite for the reaction to take place were determined. [See also Abstract 806 (1930).] F. J. B.

3866. Critical Solution Temperature of the System Methyl Alcohol-Cyclohexane as a Means of Detecting Water in Methyl Alcohol. D. C. Jones and S. Amstell. *Chem. Soc., J. pp.* 1316–1323, *June*, 1930.

The sensitiveness to impurities of a critical solution temperature, either binary or ternary, varies considerably with the impurity and in some cases is so large as to constitute one of the most accurate criteria of the purity of liquids. With the system methyl alcohol-cyclohexane, the critical solution temperature is highly sensitive to the presence of water. Cyclohexane is suitable as the second component of the system, as it is readily obtained, can be purified easily, and is readily controlled as regards purity by its melting point. The sensitiveness of the miscibility temperature to such impurities as acetone in the alcohol or benzene in the cyclohexane is of advantage when the purpose is to determine the percentage of water present. Moreover, their effects on the miscibility temperature are but slightly altered by the presence of up to 5 % of water in the alcohol. T. H. P.

3867. Changes of Physico-Chemical Properties in the Transition Zone between Colloidal and Molecular Disperse Systems. Part III. W. Ostwald and A. Quast. *Kolloid Zeits.* 51. *pp.* 361–370, *June*, 1930.

This paper continues previous work [see Abstract 3424 (1929)], and it is found that in these latest calculations only the absolute values of the diffusion constants and particle dimensions require to be altered, whilst their relationship with the composition of the solvent remains unchanged, and especially the existence of a maximum dispersivity at about 50 % alcohol. It is emphasised that the present data have only relative validity on account of the uncertainty of the theoretical assumptions, *e.g.*, Einstein's diffusion equation. The course of the variation of the diffusion coefficient and of particle dimension with dilution (concentration variability of particle size) has now been reinvestigated; but in certain cases, *e.g.*, benzopurpurin and congo red, the diffusion coefficients still remain remarkably high, and this has been experimentally investigated. It is indicated that the evaluation of the solvation pressure affords a new standpoint for the interpretation of anomalous diffusion, and the case of hæmoglobin in hydrogels is discussed. Further possible causes of diffusion anomalies, such as barophoresis (Peskoff) and intertraction (Wright), are considered. Finally, Bircumshaw's experiments dealing with the viscosity and surface tension of potassium oleate in aqueous alcohol are discussed. H. H. Ho.

3868. Degree of Dispersion of Solutions of Cadmium in Cadmium Chloride (Pyrosols). E. Heymann and E. Friedländer. *Zeits. f. phys. Chem.* 148. *Abt. A.* 3. *pp.* 177–194, *June*, 1930.

Investigation of the distribution equilibrium of Cd between Bi as one phase and $CdCl_2$ as the other, with the help of Nernst's distribution law and also of Henry's law, shows that solutions of Cd in cadmium chloride melts (pyrosols) are not colloidal but atom-disperse, the Cd being dissolved in the monatomic state. The observation that the saturation concentration is independent of the quantity of solid also argues against the colloidal character of the solution. Consideration of the condition of the dissolved Cd atoms leads to the assumption of solvation of the atoms. A simple and rapid method of determining Cd, especially in small proportion, in presence of Bi is described. T. H. P.

3869. Dielectric Constant of Non-Homogeneous Mixtures. A. Piekara. *Phys. Zeits.* 31. *pp.* 579–584, *June* 15, 1930.

Several formulæ [see Abstract 1213 (1930)] ascribe an additive character to the dielectric constants of mixtures such that $f(\epsilon) = \delta f(\epsilon_1) + (1 - \delta)f(\epsilon_2)$. The author shows that ideal non-homogeneous mixtures should not have this additive property and that they do not really possess it. In his ideal mixture neither component influences the other, and the particles are spheres in random orientation at distances large compared to their diameters. When these conditions are not fulfilled, and the particles are not spherical, the mixture is quasi-ideal. In this case the relation between ϵ and δ is strictly linear for emulsions of mercury in vaseline, but only approximately so for alcohol-water mixtures [see Abstract 956 (1929)] because the electric charge of the particles has an orienting influence. Introducing a further function ψ of the form $a\epsilon_1 + b\epsilon_2$ the author develops a formula for ϵ_2 which, for ideal mixtures having a closed phase of infinite dielectric constant, would assume the simple form $\Delta\epsilon = 4\epsilon_2\delta$. This formula can also be applied to emulsions and colloidal solutions, in which secondary influences are present and which have high ϵ_2 values or pronounced dipolar character, for the investigation of this dipole-effect. H. B.

3870. Colloidal Platinum. Part VII. S. W. Pennycuick. *Chem. Soc., J. pp.* 1447–1458, *June*, 1930.

Colloidal platinum was prepared by sparking between platinum points immersed in water. The voltage used was 200 volts, and the current 305 amperes. The sol was boiled for 25 minutes and stored for two days after preparation. The cataphoretic velocities of the pure sols were determined in a modified Landsteiner-Pauli apparatus. Colloidal platinum was shown to be a typical hydrophobic acidoid sol. In the presence of air, the surface appeared to contain acid and oxide only. The changes in the cataphoretic velocity of the particles were measured in the presence of certain electrolytes. The effect of inorganic acids was interpreted as a direct repression of the diffuse ionic atmosphere, and the linear relation of Debye and Hückel was found to hold. Coagulation process in the presence of electrolytes was discussed in terms of the results obtained. [See also Abstract 2611 (1929).] F. J. B.

3871. Constitution of Copper-Zinc Alloys. W. Broniewski and J. Strasburger. *Comptes Rendus*, 190. *pp.* 1412–1415, *June* 16, 1930.

The electrical conductivity at 0° C., temperature coefficient of electrical resistance from 0° to 100° C., thermoelectric power at 0° C., temperature coefficient of thermoelectric power from − 183° to 218° C., electromotive solution pressure, coefficient of thermal expansion at 0° C., temperature coefficient of the coefficient of expansion from − 183° to 218° C., and Brinell hardness are determined for 38 specimens of copper-zinc alloys covering the range of composition from 0 to 100 % zinc, all having been annealed at 400° C. for 1000 to 3000 hours. The curves showing the variations of these properties with composition indicate the presence of the compounds CuZn, $CuZn_2$ and $CuZn_6$, but no confirmation is obtained for the compound Cu_2Zn_3. [See also Abstract 626 (1929).] A. J. M.

3872. Hardness of Cold-Worked and Electrolytic Nickel. Guichard, Clausmann, Billon and Lanthony. *Comptes Rendus*, 190. *pp*. 1417–1419, *June* 16, 1930.

The hardness of electrolytic nickel is not due to dissolved gases, but probably arises from the extremely small crystal size. On heating samples of electrolytic nickel at progressively increasing temperatures *in vacuo*, it is found that the greater part of the dissolved hydrogen is liberated before any pronounced softening has commenced, while softening is almost complete before appreciable quantities of CO and CO_2 are removed. The hardness of electrolytic nickel is not increased by cold work, but is always greater than can be attained by cold rolling cast nickel. By prolonged annealing the Brinell hardness of electrolytic nickel, which varies from 245 to 365, can be reduced to 35. A. J. M.

3873. Effect of Tempering on Resistivity and Ultimate Shear Stress of Hardened Aluminium-Silicon Alloys. L. Guillet and M. Ballay. *Comptes Rendus*, 190. *pp*. 1473–1475, *June* 23, 1930.

Accounts of tests carried out on a series of aluminium alloys containing 0·4 % of iron and from 0·14 to 2·56 % of silicon. Wires which were quenched in water at 500° after heating for 45 mins., and then tempered at various temperatures, were found to decrease in resistivity as the hardening temperature was raised up to 350°; beyond this temperature the resistivity underwent an increase. After quenching the specimens at 600°, the effect of tempering between 150° and 200° C. is to increase the ultimate shear stress of these alloys. W. C. S. P.

3874. Texture of Sheet Iron after Rolling, and after Recrystallisation. G. Kurdjumow and G. Sachs. *Zeits. f. Physik*, 62. 9–10. *pp*. 592–599, 1930.

The experiments were carried out with electrolytic iron, and it was found that the previous descriptions of the texture of iron after rolling have been incomplete. From the X-ray diagrams, taken under the same conditions as those used by Göler and Sachs [see Abstract 837 (1930)], surface polar figures were constructed, and were interpreted as indicating the superposition of three different crystal positions with respect to the direction of rolling. It was found that after heating above the recrystallisation point the texture produced by rolling persisted to a certain extent. H. N. A.

3875. Retardation of the Velocity of Solution of Zinc by Alloying with Cadmium. M. Straumanis. *Zeits. f. phys. Chem.* 148. *Abt. A*. 1–2. *pp*. 112–124, *June*, 1930.

The velocity with which alloys of zinc (1) with platinum, nickel and iron are dissolved by 2*N* sulphuric acid is diminished greatly and (2) with gold and copper very greatly by introduction of cadmium. With Zn-Au-Cd alloys as little as 0·2 % of cadmium is sufficient to exert a very considerable effect. The mode of action of the cadmium is shown by investigations on single crystals of the alloys, and the formation of layered crystals by cooling of the melts is explained. The series Al, Mg, Pb, Tl, Cd, Hg represents the order of increasing retardation of the velocity of solution of zinc. In the case of cadmium, this effect depends on the velocity of cooling of the alloy. Even with less than 0·1 % of cadmium, zinc does not form mixed crystals. T. H. P.

3876. Treatment of Iron Alloys with Solutions of Metallic Phosphates. J. Cournot and J. Bary. *Comptes Rendus*, 190. *pp*. 1426–1428, *June* 16, 1930.

In a previous paper experiments were described on the protective coating formed when iron and steel were treated with solutions of iron and manganese phosphates. The work was continued to mixtures of phosphate of iron and zinc, of manganese and zinc, and of iron, zinc and manganese. The value of the protective coating was determined by boiling in a salt solution, and by alternately dipping the sample in and out of the salt solution. The results showed that treatment with iron phosphate formed no protective coating of value, but the mixed solutions formed coatings which were protective to some extent. F. J. B.

3877. Local Current Theory of Corrosion and Passivity. F. Tödt. *Zeits. f. phys. Chem*. 148. *Abt. A*. 6. *pp*. 434–440, *June*, 1930.

The corrosion of metals in weak alkaline, neutral and weak acid solutions is conditioned by the presence of dissolved air in the solution. The magnitude of the corrosion largely depends upon the quantity of oxygen which can act as a depolariser at the kathode. The surface of the iron kathodes is identical with the oxide layer, which also covers active iron to a considerable extent. The significance of local currents between oxide layer and the free metal was considered as an explanation of passivity and of the periodic phenomena. F. J. B.

3878. Passivation of Metallic Surfaces by Electronic Bombardment. F. Goldmann and E. Rupp. *Zeits. f. phys. Chem*. 8. *Abt. B*. 3. *pp*. 180–186, *June*, 1930.

The surface of a metal which has not been degassed is passivated on being bombarded by electrons. The track of a stream of electrons on copper can thus be revealed by treating the copper with iodine vapour. The passivation is caused by slow electrons (order of magnitude 100 volts), rapid electrons (Coolidge tube 150 kV), positive ions, and also by ultraviolet light. Degassed metals do not show the effect, even when treated with hydrogen after degassing, but when treated with oxygen degassed metals are passivated in the same way as metals which have not been degassed. It is concluded that the passivation is to be attributed to the formation of an oxide film resulting from the impacts of the electrons. A. J. M.

3879. Theoretical Significance of the Passive State of Metals. W. J. Müller. *Zeits. f. Elektrochem*. 36. *pp*. 365–371, *June*, 1930.

The significance of the passive state of metals is discussed, and the work of A. Smits [see Abstract 2343 (1930)] criticised. In his reply **A. Smits** (*ibid*., pp. 371–375) points out that the theory given by Müller is untenable and fundamentally different from that put forward by him. The objections to Smits' theory, raised by Müller, can easily be refuted and disproved. F. J. B.

3880. Measurements on Gold-Silver Monocrystals in Tension. G. Sachs and J. Weerts. *Zeits. f. Physik*, 62. 7–8. *pp*. 473–493, 1930.

The monocrystals were prepared in an electrical vacuum oven. The mixture crystals of gold and silver show alterations in properties with the composition similar to, though smaller than, those previously observed with alloys of zinc and copper. The elastic limit has a maximum for the alloy with equal atomic proportions of gold and silver. The region of elongation without hardening, after the elastic limit is passed, is most marked in the case of the alloys which are rich in gold. With further stretching the resistance to slip increases more for alloys of mean concentrations than for the pure metals. The difference in hardening between the originally active slip surface and the second one is a little greater in alloys rich in silver than in those rich in gold. The results are compared with those obtained for copper alloys. H. N. A.

3881. Equilibrium Constants of Reactions Involving Hydroxyl: a Correction. D. S. Villars. *Nat. Acad. Sci., Proc.* 16. *pp*. 396–401, *June*, 1930.

Two mistakes in a previous communication [see Abstract 1221 (1930)] are corrected. The entropy of oxygen at 298° K. should be 49·2 cal. deg.$^{-1}$. The formula for the entropy of hydroxyl was also incorrect on account of the neglect of the nuclear degeneracy of the hydrogen atom in hydroxyl. The corrected equilibrium constants for reactions involving hydroxyl are tabulated. A. J. M.

3882. Reduction of Soda by Hydrogen. P. Villard. *Comptes Rendus*, 191. *pp*. 1329–1331, *June* 11, 1930.

In continuation of experiments on the reducing action of hydrogen on glasses [see Abstract 2856 (1929)], similar observations have been made on soda heated in a tube of silver or highly refractory glass, through which a stream of hydrogen is passed. At about 800° C. the stream of hydrogen, after passing over the alkali, is highly absorbent to sodium light. The sodium vapour can be detected over a distance which, from the velocity of the gas stream, corresponds to a survival of 0·2 sec. Beyond this point the sodium recombines with the water vapour formed in the reduction. If nitrogen is used in place of hydrogen the sodium vapour is not produced, indicating that dissociation of the soda does not occur at the temperature of the experiment. A. J. M.

3883. Action of a Magnetic Field on the Rate of Solution of Iron in Aqueous Cupric Chloride. H. Forestier. *Comptes Rendus*, 190. *pp*. 1421–1423, *June* 16, 1930.

The contradictory data of previous investigators have led to the present work in which the importance of the magnetisation of ferro-magnetic substances during their chemical reactions has been clearly established. Experimental details and data are given showing the variations of the rate of solution of iron in aqueous cupric chloride as a function of the magnetic field and of concentration. The magnetic field effect may even treble the rate of solution. H. H. Ho.

3884. Water Gas Equilibrium and Electrical Discharge at Low Pressures. K. Peters and H. Küster. *Zeits. f. phys. Chem.* 148. *Abt. A.* 4. *pp.* 284–303, *June,* 1930.

The establishment of the water gas equilibrium when the streaming gases were subjected to electrical discharge was studied. It was found that the reaction $CO_2 + H = H_2O + CO - 10\cdot4$ kcal. took place. As the current density increased the reaction proceeded to its limits. Pressure variations within the limits of 20 to 60 mm. Hg had no measurable effect on the equilibrium. The change remained constant in amount at increasing rates of flow of the gas up to 710 litres per sec. The mean temperature of the discharge tube was about 300° C., and the temperature of the path of the discharge was 800° to 1000° C. A good agreement was obtained between the isotherm calculated for 1200° Abs., the exit gases containing from 25 to 100 % CO, and the curve of change at a constant load of 1·20 kW.
F. J. B.

3885. Chemical Reactions with Electrodeless Discharges. N. A. Yajnik, R. K. Sharma and M. C. Bhatnagar. *Zeits. f. phys. Chem.* 148. *Abt. A.* 5. *pp.* 394–399, *June,* 1930.

The effect of electrodeless discharges on a number of substances was investigated and the results are compared with the effect of ultra-violet light, ordinary light and heating. Phosphates, oxalates and calcium carbonate proved to be very stable under the influence of such discharges, no changes being observed with prolonged exposures. With polymorphous substances the effect of the discharge was generally to change one form into the other. [See Abstract 2165 (1928).] A. W.

3886. Interaction of Oxygen with Nitrogen after Collision with Electrons. O. H. Wansbrough-Jones. *Roy. Soc., Proc.* 127. *pp.* 511–529, *June* 2, 1930.

The method of examining the rates of reaction of gases after collision with electrons previously described [see Abstract 336 (1929)] has now been applied to the synthesis of oxides of nitrogen from their elements at pressures below 100 bars. This reaction is shown to depend on the ionisation of the nitrogen, excitation of the oxygen being unnecessary. The two principal reactions are represented by the equations $N_2^+ + O_2 = 2NO$ and $N^+ + O_2 = NO_2$ or $N_2^{+'} + O_2 \rightarrow NO_2 + N$, the independent production of either of these gases being established. The efficiency of the process is discussed, and it is shown that at the higher voltages very nearly all the ions formed will react. T. H. P.

3887. Formation of Ozone from Oxygen after Collision with Electrons. O. H. Wansbrough-Jones. *Roy. Soc., Proc.* 127. *pp.* 530–539, *June* 2, 1930.

Anomalies in the total absorption of gas observed in the reactions between nitrogen and oxygen after collision with electrons indicate possible intervention of the formation of ozone [see preceding Abstract]. It is now found that the electrochemical absorption of oxygen is a chemical process with the glass walls of the vessel and is not necessarily connected with ions. When the oxygen is dry and at a low pressure, ozone is not formed by direct collision between normal ions and molecules or between atoms and molecules. The formation of ozone is the result of collisions between oxygen molecules and excited ions having a life of the order of 10^{-7} sec. Collision between ion and atom or generally between two active species would be rare, and while showing efficiencies of the same order as those observed would not exhibit the same dependence on the pressure.

T. H. P.

3888. Synthesis of Ozone in the Glow Discharge. A. K. Brewer and J. W. Westhaver. *J. Phys. Chem.* 34. *pp.* 1280–1293, *June,* 1930.

The rate of synthesis of ozone in the positive column of the glow discharge at constant current is nearly independent of pressure from 15 to 0·3 mm., but is proportional to the power input for low pressures and current densities. The amount of ozone synthesised at maximum efficiency is proportional to the number of positive ions formed, the discharge yielding one ozone molecule per 11·9 electron volts or 150 grammes per kWh. The minimum M/N ratio is thus greater than one molecule per ion. No detectable synthesis can be attributed to neutral oxygen atoms or to radiation produced in the discharge. The effect of foreign gases is to decrease the yield. Nitrogen is most pronounced in this respect and shows no positive catalytic activity whatsoever. Argon decreases the yield nearly in proportion to the amount present. Helium in small percentages slightly enhances the yield. [See also Abstract 2968 (1930).]

AUTHORS.

3889. Photochemical Decomposition of Ozone. H. J. Schumacher. *Am. Chem. Soc., J.* 52. *pp.* 2377–2391, *June,* 1930.

The available experimental data involving the photochemical decomposition of ozone are critically surveyed and the kinetics of the reaction are explained on the assumption that the ozone spectrum shows predissociation and that the primary process is therefore $O_3 + h\nu \rightarrow O_2 + O$. In red light the formation of a normal oxygen atom, and in ultra-violet light that of an excited atom, is assumed. The probability of the occurrence of the reaction $O + O_3 \rightarrow 2O_2$ is calculated to be 5×10^{-4} if the oxygen atom is normal, and it is assumed that the reaction $O + O_2 \rightarrow O_3$ occurs only in a three-body collison. From a consideration of the influences of temperature and of foreign gases on the reaction, it appears that the effect of gases which do not react with ozone may be interpreted on the basis of their specific influence on the three-body reaction $O + O_2 + M \rightarrow O_3 + M$. If the observation that water vapour accelerates the decomposition is correct, it is explainable by the reaction of excited oxygen atoms with water vapour.

T. H. P.

3890. Application of the Stern-Gerlach Experiment to the Study of Active Nitrogen. L. C. Jackson and L. F. Broadway. *Roy. Soc., Proc.* 127. *pp.* 678–689, *June* 2, 1930.

A fine beam of atoms or molecules was produced in the apparatus described, and after passing through a non-homogeneous magnetic field fell on a screen covered with silver nitrate, ground as finely as possible. This substance is discoloured by the action of the active nitrogen, turning brown in the apparatus as finally constructed, in such a way as to exclude mercury vapour. A clearly visible trace was obtained with the field off in 2 to 5 hours; the traces were broadened when the field was on to an extent which corresponded to a splitting of the beam much smaller than that due to atomic hydrogen in the same apparatus. The whole of the evidence obtained pointed to the fact that the entity which produced the traces on the screen when active nitrogen was employed had a magnetic moment such that the splitting was ±1/3, and no evidence was obtained of the presence of atoms or molecules in other states. It was concluded that the traces were due to nitrogen atoms in the metastable $^2P_{1/2}$ state, which is one of the entities supposed by Cario and Kaplan [see Abstract 1649 (1930)] to make up active nitrogen and to explain the mechanism of the after-glow. The other entities assumed to exist by Cario and Kaplan did not affect the silver nitrate in the time of exposure employed, which could not be exceeded owing to the general blackening produced. H. N. A.

3891. Relations Between Rotation, Radiation or Absorption of Heat Energy, and "Effective Sectional Area of the Reaction," in Chemical Elementary Processes. H. Beutler and E. Rabinowitsch. *Zeits. f. Chem.* 8. *Abt. B.* 3. *pp.* 231–254, *June*, 1930.

Shows for the reaction $A + B = AB$ how the rotational impulse of the thermal motion of translation of A and B passes into the rotation of the molecule AB, and that only a positive *Wärmetönung* (absorbed radiation) makes it possible for the "effective sectional area of the reaction" to exceed the sectional area of the kinetic theory of gases. The upper limit of the sectional area and the conditions for the continuation of the reaction are dealt with. This particular form of reaction only goes on in those rare cases where radiation, or the presence of a third body, makes the attainment of a quantified energy state possible. The formulæ obtained make it possible to investigate the reaction $A + BC = AB + C$. The author concludes by stating that, when a discharge is sent through a mixture of hydrogen and mercury vapour, or when a mixture of hydrogen, mercury vapour and nitrogen is irradiated with the line 2537 Å. and bands due to mercury hydride having high molecular rotations are observed, the reaction $(2^3P_0)\text{Hg} + \text{H}_2 \rightarrow \text{HgH} + \text{H} + 0\cdot62$ volts takes place. Measurements of output show that when the distance diminishes to six times the kinetic theory sectional area the reaction commences. The high rotations of the molecules are accounted for by the theory. On the other hand, when irradiation takes place without nitrogen the reaction is endothermic, the HgH bands have small rotations, the output of the reaction is very small, and the reaction $2^3P_0 + \text{H}_2\text{O} \rightarrow \text{HgH} + \text{OH} - 0\cdot1$ volt takes place. Similar results are obtained with cyanogen bands, in which different quantified rotations are found when the bands are produced in different ways. H. N. A.

3892. Electrokinetic Potential by the Method of the Flow-Potential. H. Lachs and J. Biczyk. *Zeits. f. phys. Chem.* 148. *Abt. A.* 6. *pp.* 441–463, *June*, 1930.

An improved method [see also Abstracts 723 (1925) and 3227 (1927)] has enabled a more exact determination of the electrokinetic potential at the boundary surface between glass and water and glass and solutions of alkali chlorides. It has been found that the flow potential of water depends to a great extent on the conductivity produced by the CO_2 content. Solutions of the chlorides of lithium, potassium, rubidium, and cæsium at concentrations of $5\cdot10^{-8}$ to 10^{-3} mol. per litre have been examined and the presence of maxima for ζ established for all the salts at about $3\cdot10^{-4}$ mol. H. H. Ho.

3893. Interpretation of Colligative Properties of Weak Electrolytes. M. Randall and C. Allen. *Am. Chem. Soc., J.* 52. *pp.* 1814–1823, *May*, 1930.

The methods of Lewis and Randall for determining activity coefficients from freezing point or other measurements of the activity of the solvent are formally reviewed for weak univalent electrolytes. The procedure to be followed for acetic acid is shown as an example of the treatment of a typical weak electrolyte. A method of determining the dissociation constant of moderately weak electrolytes from a single measurement of the freezing point at 0·01M is given. H. H. Ho.

3894. Application of Moving Boundaries to a Study of Aqueous Mixtures of Hydrogen and Potassium Chlorides. L. G. Longsworth. *Am. Chem. Soc., J.* 52. *pp.* 1897–1910, *May*, 1930.

The ionic mobility relations and concentration changes on electrolysis in mixtures of hydrogen and potassium chlorides were studied, at a total chloride ion concentration of 0·1 *N*, by means of moving boundaries. The method employed was the use of rising boundaries. Two kation boundaries were formed simultaneously and proceeded at different rates. The velocity of the leading boundary yielded the mobility of the H-ion constituent of the mixture. A portion of the less mobile K-ion constituent lagged behind the H-ion constituent and gave rise to a second boundary whose velocity yielded information as to the concentration adjustment which occurred in the region of the solution which contained pure KCl. A derivation for the "regulating" function of Kohlrausch was given. It was shown experimentally that the mobility of the chloride-ion constituent varied linearly between its slightly different values in 0·1 *N* HCl and 0·1*N* KCl. F. J. B.

3895. Spatial Asymmetry of Polar Molecules and the Electrical Double Layer. B. Kamienski. *Zeits. f. phys. Chem.* 147. *Abt. A.* 4. *pp.* 288–292, *April*, 1930.

Taking known electroosmotic phenomena as basis, the author investigates the connection between the spatial asymmetry of polar molecules and the electrical double layer at chemically-invariable phase boundaries. H. H. Ho.

3896. Cataphoresis of Small Particles in Water. Dorothy A. Newton. *Phil. Mag.* 9. *pp.* 769–787, *May*, 1930. *Supplement.*

The presence of small traces of thorium nitrate in water reduces and eventually reverses the electric charge on an oil drop in the water. With water of conductivity 6×10^{-6} ohm^{-1}cm.$^{-1}$, the charge is reduced to zero when the concentration of the nitrate reaches 3×10^{-5} *N*. The cataphoretic velocity of an oil drop rises to the maximum $3{\cdot}9 \times 10^{-4}$ cm. per sec. per volt per cm. for water of conductivity 4×10^{-6}ohm^{-1}cm.$^{-1}$. In purer water the velocity is much less and falls to $2{\cdot}5 \times 10^{-4}$ cm. per sec. per volt per cm. for the conductivity $1{\cdot}3 \times 10^{-6}$ohm^{-1}cm.$^{-1}$. Addition of alcohol to the water reduces the velocity to zero when 47 % of the mixture is water. The velocity V is shown to be related to the specific inductive capacity K for water-alcohol mixtures by the equation $V = K(ax - b)$, where a and b are constants and x is the percentage of water present. A number of substances tested all acted as if negatively charged in water. Spherical drops have a far higher cataphoretic velocity than broken bits of the same substance. Solid and liquid spherical drops of all the substances tested have the velocity $3{\cdot}9 \times 10^{-4}$ cm. per sec. per volt per cm. in water of conductivity 4×10^{-6}ohm^{-1}cm.$^{-1}$. X-rays have no permanent effect on the charge of oil drops in water. T. H. P.

3897. Electroosmosis and Interfacial Electrokinetic Potentials. H. Muraoka and K. Hiruma. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 279. [18 *pp.*], 1930.

This paper gives the results of measurements to determine the amount of liquid transported by electroosmosis through diaphragms, both of earthenware and glass particle-membrane which were fused in position, and values are obtained for the interfacial potential of Helmholtz's electrical double layer by the application of the formula derived by Smoluchowski. The apparatus used in this determination differs in some points from those of recent investigators, such as Fairbrother, Hepburn and others. Electrodes of platinised platinum plates were employed, and in the measurement the polarised potentials on the electrodes and the potential drops between the diaphragm and the electrodes were eliminated. AUTHORS.

3898. Electroosmotic Theory of the Electrolytic Rectifier. A. Dobiaš, L. Kramp and O. Lebedinskaja. *Zeits. f. Physik*, 61. 11–12. *pp.* 852–872, 1930.

According to the theory here advanced, electrolytic valve action consists essentially of electroosmotic displacements of the electrolyte in the pores of the insulating solid film at the metallic electrode. In the active phase such displacement produces direct contact, whereas in the passive phase a condenser of variable capacity is set up. The parallelism between the electroosmotic properties of the electrolyte and its rectifying action is traced, as also is the influence of viscosity on the action. Oscillograms are shown and interpreted. T. H. P.

3899. Conductivity Cell for Eliminating Electrode Effects in Conductivity Measurements. T. Shedlovsky. *Am. Chem. Soc.*, *J.* 52. *pp.* 1806–1811, *May*, 1930.

A multiple electrode cell for studying the elimination of electrode effects in measurements of conductivity is described. A series of measurements of the conductivity of HCl solutions of different concentrations were made at frequencies of 1000, 2000 and 3000 ∼. Determinations were made on one concentration of KCl at the same frequencies. The assumption of adsorption at the electrodes is considered as an unsatisfactory explanation of the variations in the " cell constant " which were observed. A four-electrode arrangement gave consistent results at the three frequencies without variations in the " cell constant." F. J. B.

3900. Hysteresis of Electrical Conductivity in Colloidal Solutions. S. Visco. *Accad. Lincei, Atti*, 11. *pp.* 583–586, *March* 16, 1930.

Attempts to establish the coagulation temperatures of certain colloids by following the electrical conductivity of their solutions revealed the fact that the values of the conductivity of the solutions at any given temperature varied according as the temperature was reached by heating or cooling, higher values being obtained by the latter procedure. This hysteresis effect is explained by diminution of the viscosity, and hence increased migration velocity of the ions, in the phase of falling temperature. T. H. P.

3901. Passage of Continuous Current Through Acetone. H. Garrigue. *Comptes Rendus*, 190. *pp.* 1406–1408, *June* 16, 1930.

The current between platinum electrodes in various samples of acetone, maintained at constant differences of potential, varying from 80 to 800 volts, has been measured. It decreases for the first 20 minutes; the back e.m.f. of polarisation is considerable and capable of producing a current perceptible for 70 hours. Stirring the liquid increases the current. The fall of potential is not evenly distributed between the electrodes, conductivity being greatest near the positive, least near the negative electrode. Such potential is not constant, but oscillates. This is attributed to the interdiffusion of positive and negative columns formed in the liquid by the current, as when such interdiffusion was checked by the interposition of glass wool the oscillations ceased. Variations in purity, though causing large variations in the absolute intensity of the current, caused none in the general outline of the current-time curves. C. A. S.

3902. Conductance of Aqueous Solutions of Barium Chloride as a Function of the Concentration. G. Jones and M. Dole. *Am. Chem. Soc., J.* 52. *pp.* 2245–2256, *June*, 1930.

The density and electrical conductance of aqueous solutions of barium chloride were measured over a range of concentrations from 0·001 to 1·0 molal. The propriety of applying a viscosity correction to measurements of conductance is discussed. Equations for calculating the properties of aqueous solutions of barium chloride at 25° C. as a function of the concentration up to 1 molal are deduced. F. J. B.

3903. E.M.F. of Calomel Electrode against Hydrogen Electrode. J. Mukherjee and K. K. Kumar. *Am. Chem. Soc., J.* 52. *pp.* 2179–2184, *June*, 1930.

Some of the causes of unreliability of the calomel electrode were investigated. Low concentrations of hydrochloric acid were used, and it was found that although oxygen and mercury were both essential, mercurous chloride played an important part in the reaction which led to the formation of calomel, and to the loss of hydrochloric acid. The e.m.f. observed corresponded, within the limits of experimental error, to the actual concentration of the acid in the electrode vessel. F. J. B.

3904. Oxygen Electrode: An Adsorption Potential. H. V. Tartar and Margery Walker. *Am. Chem. Soc., J.* 52. *pp.* 2256–2264, *June*, 1930.

The behaviour of the oxygen electrode is examined, and the change of potential with a number of factors is determined. The change of potential with time, the effect on jarring the electrode and of small electric currents, and the influence of movement upon the steadiness of the potential are measured. The behaviour of the oxygen electrode is explained from the results obtained as due largely to the adsorption of ions. The experimental evidence mainly supports this explanation. F. J. B.

3905. Electrolytic Dissociation and Raman Effect. I. R. Rao. *Roy. Soc., Proc.* 127. *pp.* 279–289, *May* 7, 1930.

The Raman spectra scattered by nitric acid solutions of different concentrations are photographed, using a tube with spherical end to condense the light on to the slit of the spectrograph, and a narrow nick just before the sphere, so as to help eliminate stray reflections. Ten Raman lines are observed, four of which correspond to undissociated HNO_3 molecules, three to NO_3 ions and three to pure water. The HNO_3 lines diminish in intensity very rapidly with increasing dilution, while the NO_3 lines increase in intensity, showing a marked increase in dissociation as dilution proceeds. Microphotometric records of the intensities are used to calculate the amounts of dissociation. The degree of dissociation at different dilutions is compared with that obtained by measurements of conductivity, and a rough agreement is found. A. C. M.